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*To His Excellency
The Earl of Elgin*
LECTURES
*with the author's
highest regards.*
ON THE
VENTILATION OF BUILDINGS,

DELIVERED AT THE

Cobourg Mechanics' Institute,

BY

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P R E F A C E .

THE subject of the following Lectures, although a matter of the utmost concern to the whole world, appears to have engaged little of the attention of mankind. One reason for this may be, that the importance of breathing a pure atmosphere has never been, until within the last few years, either properly understood or its necessity enforced. Another reason may be found in the diffidence with which every person, who might be really capable of rightly thinking upon the subject, would approach a matter so purely scientific, in the face of the great names which are connected with it either directly or indirectly, in various countries. But the principal reason, it appears to me, is that those scientific men, whose attention may have been attracted by, and who have been capable of investigating the subject, have, for the most part, been inhabitants of such climates as stand in less need of the ventilation of their dwellings. Necessity, it is commonly said, is the mother of invention, and it is therefore natural to suppose that any improvement, especially in domestic economy, which more or less influences *all*, should emanate from those who are likely to be most affected by its operation.

I have myself, for many years, been anxiously looking for, and expecting some discovery by which the enormous consumption of fuel, to which under our present system of heating our dwellings we are obliged to submit, might be prevented. But what was every body's business, in this as in all other matters, appears to have been no body's business, and not even an attempt has until now been made.

It was in the course of my experiments for the economising of fuel, which, for the last few years, has engaged my attention, that I happened to stumble upon the important fact *that the principle involved in the saving of fuel was that by which alone a proper system of ventilation could be carried out!* So that, after all, it appears in this as in all other instances where the true principles of philosophical enquiry have been pursued,—Nature proves herself the most scientific agent!

It is because we interfere with, and constantly contravene, the laws of Nature, that the necessity of scientific enquiry has arisen; and this is especially the case in the science of medicine. If we would from our infancy allow Nature to *prevent* disease there could be no necessity for all that labour and toil which is now undergone in the *cure*.

The Almighty has ordained that all creation must perish, and that the process of decay shall begin with the life of every thing—animate and

inanimate. He has also provided an agent through whose influence the decomposition of all living matter shall be retarded or kept back until that goal which He has set be attained—an agent without which nothing could live. This agent is the common *ATMOSPHERE*.

If then, by any means, we throw obstacles in the way of, and prevent the universal purifier and disinfecter from executing its proper office, what can we expect but a dissolution of that organism which it is its peculiar province to protect against that constant, unremitting and inexorable enemy of all animal and vegetable life,—decomposition?

I am not so sanguine as to suppose that anything which I have written in the following Lectures will share a fate materially different from that which usually awaits such productions—negligence and perhaps for some years to come—oblivion; but I am quite certain that no other *principle* of ventilation will ever be universally adopted.

HENRY RUTTAN.

Cobourg, 1st June, 1848.

The Author begs to submit to the reader the following note from the Rev. Principal of VICTORIA COLLEGE, who, by his talents and able management, has rendered that Institution one of the most flourishing and useful in the Province.

Victoria College, 30th May, 1849.

MY DEAR SIR,—Having listened with great interest and profit to the Lectures recently delivered by you in this Town, on the important subject of Ventilation, I take the liberty of assuring you, on my own part personally, and in behalf of other members of the Faculty of Victoria College, of our high appreciation of their superior merit, and at the same time of expressing a hope that you may be induced to give them an immediate publication, in order that the valuable sentiments they contain may have a circulation as extensive as possible throughout the Province.

Affectionately and respectfully yours,

A. MACNAB.

H. Ruttan, Esq., Cobourg.

LECTURE I.

In common with many others, inhabitants of this cold region, I have been, for many years unable to shake off an apprehension that a day will come in the history of the North American Colonies and the northern parts of the United States, when their population will cease to be augmented by immigration from Europe, and other countries whose climates may be less cold and inhospitable. Nor am I ashamed to acknowledge that fancy has pictured to my mind, that some day, however remote that may be, an emigration—confined at first, perhaps, to the poorer classes of society, will take place *from* these regions *toward* the more southern parts of this continent. These apprehensions have been in no wise abated by the recent report of Mr. Logan, our Geological Surveyor, who has failed, after two or three years' investigation, to discover any coal formations within the boundaries of the Canadas.

It is true that there are Coal beds in some of the Western States, in Nova Scotia, and in Europe, especially in England, containing what appears to be an inexhaustible supply, and forests of wood fuel in Canada, which, for the present, at any rate, may be regarded as sufficient to quiet our fears upon the subject. But the question will recur—are these forests, coal, coal beds, and mines, in *fact*, inexhaustible? We know they are not. But, supposing they are, can the poor afford to burn coal even at the present prices? can they supply themselves even with wood fuel, which is as yet rather cheaper than coal in most parts of Canada? Is it not every day's observation and experience, that thousands, especially in the

Towns and Villages of Canada, and some of the Eastern Provinces, are suffering all but the pangs of starvation from cold, even now? And can it be denied—can we shut our eyes to the fact, that fuel of every kind is becoming more and more inaccessible, and gradually, but certainly, rising in value every year, all over the northern settlements of the American continent? This is especially the case with most of the Towns and the more dense settlements—the prices of fuel having doubled within the last ten years!

And here I may remark that I think it is just as imperative upon the more wealthy of the community that they supply the poor with fuel in this cold climate as with bread.—We cannot say to them in the one case, more than in the other, “Depart in peace, be ye warmed and filled, notwithstanding we give them not those things which are needful to the body,” for “whoso stoppeth his ears at the cry of the poor he also shall cry himself but shall not be heard.”

My ideas upon the coming want of fuel may by some be characterised as mere vagaries of the fancy—as puerile and visionary, and these observations as uncalled for and positively mischievous. “Let us not borrow trouble,” say such persons, “sufficient for the day is the evil thereof.” Not so, “forewarned is forearmed,” and “a prudent man foreseeth the evil, but the simple pass on and are punished.” I do not quote this because I think myself more “prudent” than thousands of others who view this subject in much the same light, but because it is a fact.

Supposing, however, that it be unnecessary for us at this time to “borrow trouble” on account of the next or future generations; it will not be denied that our own immediate *interests* lie in the direction of bringing within reasonable bounds, and economising the present enormous and extravagant consumption of fuel, and that on that account alone this subject is worthy of immediate and serious consideration—to say nothing of the preservation of health, which in my opinion is of far greater importance.

These impressions having grown upon me for many

years, it is not unnatural that I should have turned my attention in some measure to the practical accomplishment of an object to which I have attached so much importance ; and, accordingly, the experiments which I have made within the last few years have opened up to me what I consider to be one step—and the only one, I believe—in the right direction—that is, for obtaining and applying to its proper purposes, a much greater quantity of heat contained in fuel than has ever as yet been obtained, as well as a thorough ventilation of buildings.

I do not pretend that all the heat contained in the fuel can ever be made available for domestic purposes, much less that I have made any such discovery, but I have no hesitation in asserting, that the theory upon which I have already carried out its practical working, approaches such a consummation more nearly than that of any other which has as yet been made public, and that the *principles* are those *only* by which perfection can ever be attained.

The space which I have been obliged to occupy by the discussion of the *ventilating* process having extended beyond what I anticipated, I have been obliged to abandon for the present, the interesting and important subject of the properties of fire and heat, and the machinery for their development, which I had intended to comprise in the present paper. This part of my plan, which I hope shortly to lay before you, will place in its true light the enormous waste of fuel incident to the present system of warming our dwellings.

Before I proceed any farther, it is necessary for me to say that I have no pretensions to *science*, in the strict sense of that term, and that whatever of philosophy may be discovered in the theory and practice of ventilating buildings, which I am about to propound, is in this case nothing more than that which lies at the foundation of all philosophy, and without which no science could exist or be comprehended—common sense ; or, in other words, “The due selection, arrangement and adaptation of the

laws of nature, to the attainment of a desired end or purpose." It is in this sense only, that I have any claim to being considered an "inventor." Indeed, it is the only sense in which that term may be used at all; for that "there is nothing new under the sun," is just as true now as it was three thousand years ago. The Magnetic Telegraph is nothing *new*—it is, or at least all its constituents are, as old as creation itself. The effects which we witness are merely the result of "the due selection, arrangement, and adaptation of the laws of nature to the attainment of a desired end or purpose," by some person or persons who have happened (accidentally, perhaps,) to turn their attention in that direction; and who, by means of experiments, have produced the effects which we witness. My "invention" is a mere discovery of this kind—at a *very* humble distance I admit—but nevertheless, the effect of a close attention to this particular subject, and of experiments founded upon a train of thought naturally suggested by it.

I have said that I have no pretension to science; this, however, must be so qualified as to allow me the privilege of understanding so much as may enable me to make use of the *terms* necessary to prove, as I go along, that my theory and practice of ventilation are perfectly consistent with the whole range of those branches of philosophy, which are naturally incident to the work which I have taken in hand.

To the scientific alone, I am aware, that the manner in which I shall treat this subject, will be considered much too diffuse; and, perhaps, as containing a fulness of explanation and illustration, approaching to redundancy—whilst to those wholly unaccustomed to scientific investigation I shall, from an error on the opposite side, fail to make the general principles of so complicated a subject fully understood. My desire, however, is to carry my instruction, if such it shall be considered, into every family, and to every individual. Health is a matter of universal concern.

If my subject be original, certainly my manner of treating it will be considered not less so; and at the hazard of covering the grain of wheat with a bushel of chaff, I shall make my quotations, explanations and illustrations, follow closely upon every thought. Indeed where so much explanation is required, as in this case, where the subject is the result of original thought alone, unaided by the experience of others, frequent digressions, in explanation, are unavoidable.

Every pretender to any new discovery, whether he tells you so, or not, wishes to be considered a practical man, and especially if he be engaged in the practical application of the physical sciences; and I can see no good reason why I, amongst the rest, should not also desire to be included in the list. I have succeeded in thoroughly establishing the principle, by the construction of machinery and apparatus, however imperfect in the detail, which accomplish the object sought. All this too, by means so obvious and simple that, but for the assurance of scientific men (with whom I have communicated, both with regard to my plan of ventilation and the absorption and radiation of heat,) they are original, I should hesitate to believe that, amongst the amount of scientific research upon the properties of heat and air, it had never been hit upon.

When I say that I am a *practical* man, I mean practical in contradistinction to a *mere theorist*. It must not therefore be supposed, that in the discussion of this subject I repudiate philosophy, on the contrary, I intend to prove by the experiments of others, based upon philosophical data, that my systems are based upon those immutable laws of nature, which, when properly selected, arranged and applied, produce the effects which we can readily trace back to first principles. It is further necessary to explain that the word *practical* has a two fold meaning. The man who *by experiments* is enabled to produce effects from causes, which lie concealed from the ordinary and every day observation of the generality of mankind, and

who by such process discovers and exhibits properties in matter, which, while they appear impossible and repugnant to sense, are nevertheless brought into the practical and useful purposes of life—is a practical man. So also is the artisan—the man who makes the patterns—moulds, casts, and manufactures the engine, and carries out the principles laid down by the experimentalist, to some practical and useful purpose. In short the distinction which I make between the *practical* man and the mere *theorist* is, that the one always builds upon *truth*, and the correctness of whose theory is proved by its perfect consistency with the whole range of philosophy; whilst the other erects a fabric upon a foundation which however specious and reasonable, is entirely false, and relies for ~~truth~~ wholly upon the fallacies suggested by the external senses. *proof.* Therefore, before I enter upon the subject generally, which I have undertaken to discuss, it is necessary for me to shew that the external senses, however useful, and indeed necessary, they may be, are not of themselves to be depended upon as sufficient evidence in all cases, and especially are they fallacious in guiding us aright on the particular matter in hand—that whilst our senses of touch, and sight which are those chiefly to be brought into requisition, may be gratified, our health, strength and mind may be endangered if not utterly prostrated.

I shall make no apology for drawing upon others, in order to prove that if we wish to maintain our health and strength of mind and body at the same time that we attend to the gratification of our senses, and the economising of our means, we must, in warming and ventilating our dwellings, repudiate that, I will not call it theory, but system, which depends upon the external senses only, and follow out that which springs from a philosophical examination of the laws of nature.

“Of all the means,” says Doctor Lardner, “of estimating physical effects, the most obvious, and those upon which mankind place the strongest confidence, are the

senses: the eye, the ear, the touch, are appealed to by the whole world as the unerring witnesses of the presence or absence, the qualities and degrees of light and colour, sound and heat. But these witnesses when submitted to the scrutiny of reason and cross-examined, so to speak, become involved in inexplicable perplexity and contradiction, and speedily stand self-convicted of palpable falsehood. Not only are our organs of sensation not the best witnesses to which we can appeal for exact information of the qualities of the objects which surround us, but they are the most fallible guides which can be selected. Not only do they fail in declaring the qualities or degrees of the physical principles to which they are by nature severally adapted, but they often actually inform us of the presence of a quality which is absent, and of the absence of a quality which is present."

"The organs of sense were never, in fact, designed by nature as instruments of scientific enquiry; and had they been so constituted, they would probably have been unfit for the ordinary purposes of life. It is well observed by Locke that an eye adapted to discover the intimate constitution of the atoms which form the hands of a clock, might be, from the very nature of its mechanism, incapable of informing its owner of the hour indicated by the same hand."

"The term heat, in its ordinary acceptation is used to express a feeling or sensation which is produced in us when we touch a hot body. We say that the heat of a body is more or less intense, according to the degree in which the feeling or sensation is produced in us."

"The touch, by which we acquire the perception of heat, like the eye, ear, and other organs, is endowed with a sensibility confined within certain limits; and even within these we do not possess any exact power of perceiving or measuring the degree or quality by which the sense is affected. If we take two heavy bodies in the hand we may, in many cases, be able to declare that one is hea-

proof.

vier than the other, but in what degree or how much, our sense fails to inform us."

"If we look at two objects differently illuminated, we shall in the same way be in some cases able to declare, which is the more splendid, but the exact difference in the illumination we shall be unable to decide. It is the same with heat. If the temperature of two bodies be very different the touch will sometimes inform us which is the hotter, but if they be nearly equal, we shall be unable to decide which has the greater or which the less temperature."

Feeling can never inform us of the quantity of heat which a body contains, much less the relative quantities contained in two bodies. Heat in its latent state can never be felt at all; for example, ice—cold water and ice appear to be of the same temperature, but the difference is considerable.

"If we hold the hand in water which has a temperature of about 90° , after the agitation shall have ceased we become wholly insensible of its presence, and shall be unconscious that the hand is in contact with any body whatever. We shall of course be altogether unconscious of the temperature of the water. Having held both hands in this, let us now remove the one to water at a temperature of 200° , and the other to water of a temperature of 32° . After holding the hands for some time in this manner, let them be both removed, and again immersed in the water at 90° ; immediately we shall become sensible of warmth in the one hand and cold in the other. If therefore, the touch be in this case taken as the evidence of temperature, the same water will be judged to be hot and cold at the same time."

If, in the heat of summer we descend into a cave, we are sensible of cold; but if in winter, then we have the sensation of warmth. Now a thermometer suspended in the cave will always shew the same temperature.

Thus we see that the sensation of heat depends as much upon the state of our own bodies, as upon the several

agencies which excite the sensation. If we step out of a warm bath into the air at the same temperature, we shall experience a sensation of coldness, because air being a more rare and attenuated substance, a less number of its particles are in actual contact with the body.

If we step into a room of a high temperature, say 120° , the carpet will feel cool and the tiles of the hearth or the chimney piece will be insupportably hot. If we enter a room of low temperature, say 32° , the reverse is the case—the carpet will feel warm, and the tiles and chimney piece very cold; yet the temperature is the same. If we wrap a thermometer in a blanket and lay another upon a piece of marble in a room of any temperature, the indications will be the same in both cases, yet to the touch the two bodies will be very different—the one will feel cold, the other warm.

I shall not detain you by multiplying quotations or examples upon the fallaciousness of the sense of feeling, although this is, perhaps, the most exposed to have its impressions misinterpreted. All the other senses are more or less obnoxious to the same charge. The inadequacy of the sense of sight, however, as well as of the others, must hereafter be referred to as constituting a very important; if not indeed, the only cause or ground-work of the present vicious systems of warming buildings. The reason of this observation will appear hereafter. In the meantime I shall proceed to point out what I consider to be the principal defects of, and objections to, all the present modes by which our dwellings are heated.

1st. The common fire place.

There is no observation more common than that this mode of heating houses is the best. That it is upon the whole preferable to any other now in use, I believe, but I deny that there is no better way. I shall here say nothing of the enormous consumption of fuel, this will be referred to upon another occasion.

In the first place, if your room be a perfectly close one,

you cannot keep fire in it at all, for there will be no draught to your chimney. If, then, the open fire place requires a certain quantity of air to be admitted into the room, this air must of course be cold, and local currents of this material will be established from every crack, crevice, and aperture in the room, toward the fire place. These innumerable currents of cold air ~~converge~~ toward the chimney, and when near the hearth, form one continuous sheet of cold air floating close to the floor; for wherever the cold air enters the room, being heavier than the air already rarified, it immediately falls down toward the bottom of the room. To estimate the quantity of air which enters even the closest made room heated by a fire place, it is only necessary to hold your hand, or head if you like, over the top of the chimney for a moment. All this volume of air must be drawn *into* the room or it could of course not go *out* of it. The greatest draught of air thus drawn into the room, all other things being equal, will be directly in front and at the sides of the fire place, through the floor and side walls—the velocity of the current growing less and less toward the farthest side of the room and up the side walls, until at or near the ceiling, whence, in most rooms the draught has a tendency *outward*. The warmest place in any room, heated how you like, is within a few inches of the ceiling; and an aperture of one square inch made here will lower the temperature by allowing the warm air to *escape*, more than one of twenty square inches made in the floor, allowing the cold air to *enter*.

There is then a constant current of cold air from every part, and close upon the floor, of the room toward the centre of heat, increasing in both volume and velocity as it approaches the chimney, and the more rapidly in proportion as the draught of the chimney is good. The rarefaction and consequent expansion of the cold air drawn into the room, begins the instant it enters, and of course after a very short downward direction, gradually rises, and the more rapidly as it approaches the heat of the fire. Thus

you perceive, the bottom of a cylinder of air is formed near the floor, the bottom turning *toward* the fire and the top of the cylinder *from* it; those currents which take their rise midway or at the farthest side of the room, in general, rising above the arch of the fire place and ascend to the ceiling—and that part only of the air-cylinder which comes within the immediate attraction of the draught of the chimney, going up the flue; so that the air in a room thus heated has a constant rotary motion, supplying the draught of the chimney from the under side of the cylinder, similar to the flax leaving the distaff of a spinner.

Converge

If I have made myself thus far understood, you can have no difficulty in appreciating my objections to this mode of heating a room. The temperature in the first place, must be unequal; this is a serious objection, especially to persons of delicate health, and always unpleasant and inconvenient where there are a number of persons in the room, both to those who are nearest to the fire, as well as those who are farthest from it. You can never have warm feet in any room heated in this way. The nearer the fire you sit or stand at any place beyond the hearth, the colder will be the bottoms of your feet, because the draught is greatest there. The warmest place for the feet in such a room is that farthest from the fire place, because the draught is less.

But a far greater evil is the continual and never-ending fog of dust in which the whole of the inmates are enveloped. If the sense of vision were equal to it, you would be astonished to see the enormous quantity of filth which must be taken into the lungs from the body of dust in this state of ebullition, (and this is common in a greater or less degree to all rooms heated by any of the present modes,) and especially in a room cursed with an invention called a carpet. How it is that life is prolonged to the extent it is under this unnatural treatment is to me astonishing. As I am no physiologist, however, and as I am here dealing with facts, it would be foreign to my purpose to pursue this

idea. I therefore drop it where it is ; leaving, however, on record, my public testimony added to that of the whole body of the medical profession without an exception—that the lungs to be and remain healthy and vigorous in their action must be supplied with *pure air*.

It is indeed wisely ordered that our organs of sense should be constructed for actual and practical use, rather than that they should by the delicacy or grossness of their sensation, render us miserable ; and it is especially so with the eye. It has already been observed that the eye which is capable of discerning the atoms of which the hands of a clock are composed would fail to inform us of the hour indicated by the same hand. On the other hand it may be added, says the author, that a pair of telescopic eyes which would discover the molecules and population of a distant planet, would ill requite the spectator for the loss of that ruder power of vision, necessary to guide his steps through the city he inhabits, and to recognise the friends who surround him.

But although no dependence can be placed upon the manifestations of our senses as to what may be good or evil, useful or injurious, yet the Almighty has endowed man with a mind and a capacity to investigate, scientifically, all subjects connected with his physical existence : and this he is as much bound to do as he is to investigate those laws which He has placed before us for a guide in our moral existence. If, therefore, by ordinary observation we cannot *see* the contamination of the atmosphere which we breathe, this is no more a reason why we should set at defiance all experience, both personal and scientific, as well as the evidences furnished by all our other senses, both internal and external, than it would be for a man who would swallow a poisonous drug merely because he could perceive no difference either in colour or substance, between it and a cup of tea.

The air of a room has to our sight no colour, yet we know it is blue. We know that the sea is green, yet there

is not the slightest indication of colour in a glass full of the water. If as we have seen, we remove our hands from water at 200° to that which is at a temperature of 100° it feels cold, yet we know it is warm. If, therefore, the senses of seeing and feeling, and in fact all the others, are so imperfect or rather, I should say, such erring guides, is it not reasonable that in all matters relating to our health we should have recourse to sources of information other than those which we know may lead us astray? The fact that in carpeted rooms we are living enveloped in an atmosphere of dust is sufficiently proved even by the ordinary sight. The rays of a rising or a setting sun accidentally entering a window frequently exhibits this to the naked eye, and to such an extent, frequently, that the beholder involuntarily moves away, as he supposes for the moment, from its influence. The whole room is filled with it, and in constant motion; and so long as woollen carpets are in use, and any of the present modes of heating houses be persisted in, so long will the inmates of such dwellings be subject to this health-destroying respiration.

With those, if there be any such, who doubt the evil effects of breathing an impure atmosphere, I cannot argue. If the first, constant, and never varying advice of the whole medical world to unhealthy persons, especially those whose lungs may exhibit symptoms of being affected; if the notorious fact, that millers, stone cutters, lime burners, coal heavers, painters, and indeed all artizans and workmen whose avocations compel them to live in such an atmosphere, are unhealthy and generally short-lived, will not convince them, then nothing that I could say would have that effect.

In support of what I have here advanced, I will make one extract. It is from the proceedings of the British Association for the advancement of Science.

"Dr. McIntosh read a communication from a medical student on a disease of the lungs, caused by the deposition of particles of dust. It would contribute, he observed, to-

ward the elucidation of that class of diseases affecting artizans, which had in a more systematic form, been treated by Mr. Thackary. In the neighbourhood of Edinburgh were many stone quarries, and the workers in which not unfrequently died of consumption. A mason, a worker in the Craigleith quarry was ill; he was bled and treated for a common cold, recovered and returned to his work. A short time afterward he was again taken ill, and two years after the first attack he died." The account goes on to give the details of the appearances of the lungs on a post mortem examination, and adds "He directed particular attention to this analysis, for Dr. William Gregory had published an account of the Craigleith quarry stone, and the analysis of this stone gave the same ingredients as those found in the lungs of the workman. Dr. Gregory found in the stone carbonate of lime, silica, and alumina. The deduction must necessarily be," he adds, "that this must be an absolute deposition of the Craigleith quarry stone, from small particles taken into the lungs, during respiration, producing consumption and death."

I cannot resist giving an extract also from Dr. Fitch's lectures on the "use of the lungs, &c."

"Inhaling or drawing in large quantities of dust, will cause a deposition upon the lungs, and thus by mechanical irritation lead to consumption. This is seen in stone cutters, millers, dry grinding of metals, pickers and sorters of rags for paper making, and many others. I once knew a case of a stone and marble cutter, who died suddenly. His chest was opened and it was found that a large proportion of both lungs was so impregnated with stone dust as to have caused his death. This case occurred in Cincinnati, Ohio."

But, say the ladies, how can we do without a carpet? and then, too, they are so warm and comfortable!

Of course the ladies must be gratified; far be it from me to desire to deprive them of a single indulgence, but I must be permitted to demur to the charge that there is vulgarity

in the absence of carpets. They are fashionable, I admit, but that is their sole recommendation. I have not the least doubt in my own mind, that to the health of persons using them, they are the most destructive thing possible, and that the sins of those who persist in their use, will be visited upon their children to the third and fourth generations. Our ancestors were vulgar in their notions, in their language, dress and manner of living, according to our ideas, in the middle of the nineteenth century, but where are the robustness, vigor, health and energy of character which distinguished those of the sixteenth century? This period of early dinners, wainscoted houses and polished floors? Now I insist upon it, that a polished floor or a floor covered with a well kept oil cloth, albeit the former may be somewhat more expensive, so far from being vulgar, would in my humble opinion be the very reverse. If a general or common use of an article of furniture be the test of vulgarity, then I submit that a carpet comes pre-eminently within the category (for scarcely a house can be found which cannot boast of its carpet,) and ought, according to such reasoning, to be repudiated on that account alone!

Now as to the assertion that a carpet adds warmth to a room, I must again be at issue with the ladies. It does not, and here are my reasons for the assertion. In the first place, since carpets have been in use by every body builders never even pretend to season their flooring; before even the plastering of the House becomes dry, the rooms are covered with carpets. The consequence of this is that in less than a twelve month, the floors become open as sieves. If they are washed two or three times a year this process is obliged to be done with the least possible quantity of water, lest the ceiling of the lower rooms be spoiled, so that the timber becomes perfectly dry and shrunken, and your carpet is almost the only defence left against the constant draught of cold air always circulating between the joists.

I cannot perhaps more satisfactorily rebut the assertion that a carpet adds warmth to a room, than by relating, as shortly as possible, an altercation which occurred some years ago, and to which I was a witness, in a stage coach between Toronto and this place, and between two gentlemen, disputing as to which side of the Buffalo robe, which they shared between them, was the warmest next the person. The one contended stoutly in favour of the fur side, and by various arguments but chiefly by the sense of touch or feeling, converted nearly all the passengers to his way of thinking; and after some time, with perhaps less deference than exactly became a person so much the junior of the gentleman who shared the robe with him, and who had wrapped it around with the flesh side next him, deliberately twisted his half of the "Buffalo" with the fur side inward. This posture of affairs, of course,—the ~~fur~~ *feet* of both being left exposed, in a cold and boisterous December day, could not last. The elder gentleman, after a little, turned toward his companion, and after administering a severe but gentlemanly rebuke for the liberty the young man had taken, asked him whether, if the fur side of the robe next the person were the warmest, he did not think *the animal who furnished it would have so worn it!* The gentleman rightly judging that the animal knew best how to wear his own hide! This ridiculous, though perfectly philosophical argument, after some further conversation among the passengers generally, not only restored the covering to the old gentleman's feet, but immediately created a revolution amongst all the robes in the vehicle, and a hearty laugh at the youngster's expense.

Now if the carpet could be placed *underneath* and against the floor, I admit that a good deal of cold might be excluded; but upon the *top* of the floor, like the fur side of the "Buffalo," the ingress of the cold air by capillary attraction of the carpet would be much facilitated instead of being prevented.

2nd. The Stove.

And here I may premise that if I have condemned the open fire place for dust and cold feet, I may denounce the stove for dust, dirt and hot heads. But the condemnation of this mode of heating dwelling houses has now become nearly universal, and were it not for the want of a substitute in the matter of economy, would long ago have been exploded altogether. I shall therefore condense my remarks upon it as much as possible.

The moment you place fire or heat in the centre of a cold room, having no open flue in it, that moment every particle of air within that room is put in motion. This motion is upward from the centre of heat and rotary, similar to the water in a boiler or cauldron placed over a fire; rising from the centre to the top, thence outward and down the sides of the boiler, until it again reaches the spot it started from, and so on. The hotter your stove gets, the more rapid will be the state of ebullition. Every step taken upon the carpet, especially when near the centre of such a room, a quantity of impalpable dust is sent to the ceiling, until the whole room fairly becomes hazy. As proof of all this you have only to examine the tops of your book-cases, window cornices or shelves of any kind,—covered with dust; and, in the best kept room, you may write your name every five minutes in the day upon the furniture, especially if it be placed near the walls of the room. It is because of this motion of the air that we avoid taking a wall pew in church, there being in winter a constant current of cold air directly downward, and for the same reason this seat is preferred in summer.

The local currents of cold air in a stove heated apartment are very slight. During the time the room is heating up in the morning the expansion of the cold air by rarefaction is considerably more than sufficient to supply the necessary combustion air, and, consequently, instead of a draught *inward* it is during this period *outward*; but after the room has obtained its maximum of heat even then the ingress of cold air is little more than sufficient for this pur-

pose. A room will be heated much more rapidly when the stove is placed in a central position in the room, where all parts of the hot metal shall be freely swept by the current of air, than if it be placed near one of the walls, where but one or two of the plates are obliged to do the work of the whole. The feet in a stove room are kept warmer than in one having an open fire place, but the head is about thirty degrees warmer! so that the difference of temperature between the head and feet in the two cases is far greater, and therefore more injurious in a stove room than in one heated by a fire place. All these evils, however, fall into utter insignificance when compared with that of respiration!

"The air is a compound substance;—of 100 parts of pure air; reckoning by weight, about 76 parts are nitrogen, 23 oxygen, and 1 carbonic acid gas and watery vapour. Both as respects weight and bulk, nitrogen forms the chief ingredient of the atmosphere. This gas, which is sometimes called azote, acts chiefly as a diluent to modify the strength of the oxygen, in the same way as water is sometimes used to mix with and modify spirits. *The oxygen is the active and essential part of the air.* It serves to keep up combustion or burning, and is the principal element required for the breathing of animals and the life of plants. In serving its many purposes, oxygen undergoes a material change, but the nitrogen which conveys it is seldom altered in character. *Animal respiration changes the constitution of air; oxygen is destroyed or deposited in the blood, and carbonic acid is given out in its stead. Thus we inhale pure air, and exhale that which is foul, carbonic acid being an impure and heavy species of gas.*"

I quote this passage to shew what pure air is, and how breathing or taking it into the lungs "destroys the essential and active part, the oxygen gas," (you will please remember that I quoted from Mr. Jackson, that "oxygen gas is the life giving principle in the air.") Now, in order to estimate the evil of a stove room, let us imagine a

close apartment, into which little, if any, more fresh air, (if, indeed, you can call that fresh air which is drawn through the pores and apertures of the sodden timber of the floor covered with dust and a carpet, through both of which it is filtered,) enters than a sufficient quantity to supply the stove with combustion air. This *fresh air* (?) being heavier than that within the room, of course always keeps below that level in which the inmates take their breath. Suppose this to be an ordinary sized room, inhabited by an ordinary sized family, say six persons; suppose then that the air of this room supplies the lungs of these persons for fifteen out of the twenty-four hours. This room is shut up at night, and, in the morning, after the dust has been again thoroughly set afloat by these nuisances, brooms and dusting brushes, with the addition of the stove ashes, is again "heated up." And supposing this routine continued during a whole winter, can there be anything more shocking than the state in which the air of such a room, without ventilation, must be! It is well for us that our vision and sense of smell are not equal to its perception.

It may be supposed that the opening of a window or two in the morning and the occasional opening of the door during the day will in some measure be a sufficient ventilation. This is not the case. The opening of *all* the windows and doors in a room, *unless there be a draught through the house*, from outside to outside, and that too in nearly opposite directions, has little or no effect, and even where this is the case, and it be frequently attended to, only about one half the air in the room is changed. I have already stated that the warm air lies at the top of the room and the cold at the bottom; it follows therefore, that all the air above the point at which the sash is raised, remains undisturbed, and very likely some part of the air in a room may remain within it for weeks, perhaps months! Indeed the practical fact is, that under the present custom of opening a single window for half an hour in the morn-

ing (and perhaps not even this,) the same identical air or some part of it is breathed for months!! It is quite a mistake to suppose that because the room is cold in the morning the air is therefore fresh and pure: nineteen twentieths of it is the same that was shut up in it at night. It has merely lost its temperature, and the same air is again heated up, and this round continued all winter!

It really horrifies one to contemplate much more to name it, but a stern sense of duty compels me to allude to the quantity of contaminated and putrid matter which, under such circumstances, must be inhaled, and what is still worse,—*shared with each other!!!*

If it were not for the generosity of the Carpenters, Joiners, and Bricklayers in providing so munificently for the free ingress of the weather through our floors, walls, doors, and windows, thousands upon thousands would be added to the present lists of mortality, much the greater proportion of which is made up by diseases originating in the contamination of the blood by means of impure air, and who die without ever having suspected the original cause of their maladies.

It will be remembered that I have now been speaking of *dwelling houses* heated by stoves. With our public inns and boarding houses it is fully as bad, if not worse. There would be somewhat of a drawback in favour of our Churches, Chapels, Theatres, Prisons, Hospitals and Asylums, and other places of public resort, on account of the absence of carpets, provided they were not in general so dirtily kept; but as it is, the disturbance of the dust upon the floor by the movement of a couple of thousand feet in our Churches, to say nothing of the absorption of the oxygen by a thousand sets of lungs; or what is still worse, the dense masses of people composing the nightly audiences of the meeting-houses and lecture-rooms in our large towns, must impress every thinking person with the importance, nay absolute necessity of some step being taken to arrest the pernicious system of stove heating.

With private families and taverns and boarding houses we cannot of course interfere, but I insist upon it that our public authorities ought to be held responsible for the due and proper ventilation of the public places of resort, but especially our Hospitals, Gaols and Asylums. It is well that travellers, in general, are confined within the cabins of steamers and rail cars but for short periods. If it were otherwise, I am satisfied that the miasm and putridity of these loathsome apartments, especially at night, sensible even to the olfactories of the most obtuse nerves, by the stench emitted from the lungs of persons frequently affected by diseases of the most revolting nature, would, and in fact does as no person who has had the misfortune to experience it can doubt—infect thousands of individuals to the ultimate destruction of their health. These vehicles may be ventilated with very little expense.

3rd. Steam or hot water.

This mode of heating buildings is preferable to that by the stove, but not equal to the fire place. The oxygen of the atmosphere cannot be so utterly destroyed by it as it must be more or less by the hot metal plates (frequently overheated through carelessness,) of the stove. But like the stove heated building, *they will not admit of ventilation*, because there is no *additional* quantity of air brought into the building. I shall hereafter more particularly explain how it is that no building heated by either of these modes can ever be ventilated in a cold climate. However, the cumbrousness and expensiveness of steam heating for ordinary purposes, renders any lengthened remarks here, unnecessary.

4th. Hot air.

I now come to the last and most pernicious of all systems of heating buildings. It may surprise those of you who may have happened to become acquainted with the experiments which I have been making for the last few years upon this subject, that I should repudiate hot air. Nevertheless, I do denounce and condemn it in the most

unequivocal manner. I have thoroughly tested and have found it to be the most vicious of the vicious modes of heating a dwelling house.

Before I point out all the evils attendant upon the "Hot air" system, it will be necessary for me to review, as shortly as possible, however, its present state.

It is but a few years since it was introduced upon the continent. It was, I believe, borrowed from Russia, where what is called "The Russian stove" is used in order to disseminate a general warmth throughout the whole dwelling, or rather so far to raise the temperature of the building as that by ordinary additional fires, the inmates may, in that intensely cold region, be kept comfortably warm. I have never seen one, but so far as I can learn, the material of which it is constructed is clay, in some instances, amongst the nobility, a species of porcelain, and is made in all shapes and sizes, cylindrical, pyramidal and rectangular, but in all, very thick sides or walls. It is obvious that in a climate where they dare not allow a suspension of artificial heat either by night or day, this invention is the only one which will accomplish the object of keeping up a continual heat;—for the walls or sides of the stove are so thick, and the material so slow an absorber and radiator, that any quantity of fuel, sufficient at all events to last a whole night, may safely be put into it; and there being always such a quantity of ignited fuel or coals of fire within this chamber, that fresh fuel will need little or no additional quantity of combustion air, and therefore no flame to endanger the chimney flue or pipe, as with the metal stove. This machine must give out an equable and pleasant heat, but you cannot *ventilate* with a Russian more than with a metal stove.

There is I believe little doubt but that the idea of a metal stove was taken from the Russian invention. I cannot trace its history back to its first construction and use, but it is quite certain that as an absorber and radiator of heat, for which it is solely intended, little, if any, improvement

can have been made; for amongst the myriads of forms, shapes and fashions the metal has been made to assume, not one single philosophical idea appears to have been either suggested or adopted. And this is the more to be wondered at when we reflect that there is perhaps not a single trade or calling upon which more competition amongst the manufacturers has been exerted than in the stove manufacturing business.

It will be easy for you to judge of the improvement which has been made in hot air machinery, when I tell you that setting a large (the largest that can be found) metal stove in the cellar, with as many sheet iron pipes and elbows as can be crowded upon it, (to increase the surface as they say!) enclosing the whole by a brick wall, leaving a certain space around for a hot air chamber, and a few apertures through the outer walls of the chamber to admit perhaps a square foot or so of cold air, and then conducting the hot air from the top of this hot air chamber by tin tubes upward through the floors of the rooms to be heated, forms about the sum total of the "inventions" of the "hot air" operators of the present day!

One of the principal, amongst many other, reasons, why greater progress has not been made in this important branch of science which comprehends the warming, (ventilation has not been thought of,) of buildings is, in my opinion, attributable to the great and fundamental error of all those who have attempted it, in their not being able to divest themselves of the idea, that the same principles by which the generation and power of steam have been effected must be those, or analogous to those, upon which hot air is to be produced. Now the fact is that from the beginning to the end, they stand in most respects, in all that regards their production, use and operation, *opposed* to each other. The one is *generated*—produced from another body—the other is capable of receiving a change of temperature only—steam acts from and by propulsion—air by attraction only—steam may be speedily changed in

form—air never. All this, it is too obvious to need further remark, arises from the difference in gravity and power of expansion, of water and air—those of water being nearly two thousand times that of air.

It will be found, upon examination of the system (for there is but one amongst them all) of heating houses pursued by the hot air people that they have entirely lost sight, or been ignorant of, the following general and important principles and properties of *heat* and *air*. As for ventilation the thing has never been attempted by any of them.

1st. That the life-giving principle of the common atmosphere is much injured (if not destroyed) by heat.

2d. That its power of expansion when heated in any of the ordinary ways, is small, not exceeding perhaps forty per cent.

3d. That it circulates or moves naturally by repulsion or attraction only.

4th. That cold air cannot be heated by hot air; and

5th. And most extraordinary of all—that heated air is lighter than cold air.

Before I proceed to the correction of the errors just mentioned, it is necessary that I should say that whatever discoveries I have made in this department of the sciences, are wholly the result of long, close and practical observation, but, at first, with no other view than the mere gratification afforded to perhaps a rather inquisitive disposition, for the moment. In committing these thoughts to paper and bringing them before you, therefore, I claim at your hands an immunity, to a certain extent, in the use of terms, and also the right to adhere to expressions which, if not strictly scientific, shall be such as will be understood by practical men, and in a practical sense. Indeed, unless we become utilitarians in this utilitarian age, and are allowed a latitude beyond that which was enjoyed by our fore-fathers, we should scarcely, now-a-days, be understood. Even the very rudiments of our language are

threatened with a modernisation altogether incompatible with those rules prescribed by our progenitors. I do not mean by this to repudiate those terms which learned and scientific men employ in those enquiries which are necessary to trace effects to their causes ; all I desire is, that my phraseology, if it shall happen to be objectionable to the merely scientific enquirer, may not be construed to detract from its obvious meaning when it shall be consistent with the general and practical view of the subject taken as a whole. If I lay my hand upon a piece of marble and say that it is *cold*, I do not wish to be understood as denying that this is philosophically not true ; but whilst I assent to this as a *philosophical* untruth, I claim also that my assertion shall be considered a *practical* truth. If my positions, assertions, or opinions, merely speculative though some of them may be, should fall short of, or exceed the theories of a merely philosophical enquirer, and shall, nevertheless, be found to work out a practical result, and one which cannot be successfully controverted, I demand for such, an immunity from critical observation.

With these prefatory remarks, I proceed to shew that all hot air inventors, judging from their operations, have either lost sight, or been ignorant of

1st. That the "life-giving principle" of the common atmosphere is much injured, if not destroyed, by heat.

They are either ignorant of this fact or else they are practising an imposition upon those who, from various circumstances, have never had their attention awakened to the enquiry,—they may take either horn of the dilemma. I am inclined to the charitable side, and attribute it to ignorance rather than to a desire of making money at the expense of the health of those by whom they may be employed.

Of pure atmospheric air, oxygen forms about one-fifth part of its bulk, as we have already seen, and the other four-fifths, called nitrogen, acts as a diluent to modify the strength of the oxygen. If, therefore, Nature has so ap-

portioned the constituents of the air which it has supplied for breathing, we must conclude that any other mixture would be unnatural, and therefore unfit for healthy respiration.

And this is a fact. One of the most wonderful phenomena in nature is, that notwithstanding the great diversity in temperature, notwithstanding the constant motion in every direction, of the body of atmosphere surrounding the Globe, the same relative proportions of gases are always found to be its constituents, unless interfered with by the operation of some local cause. Such is the provision made by the all-wise Creator for the sustentation of the whole animal and vegetable creation. Dr. Reid in his researches on the quantity of air required for respiration, states that on the occasion of his experiments on the admixture of foreign gases with the common atmospheric air, one-five-thousandth part of sulphuretted hydrogen was enough to "knock up" a whole room full of persons, and produced very serious effects. And Professor Liebig says "the air is rendered incapable of supporting the process of respiration when the quantity of its oxygen is decreased 12 per cent." The is less than one-eighth part. How careful then should we be to preserve this precious commodity in its purity!

Now, if we in the same way take nature for our guide in the *temperature* of the air we breathe, as well as its *constitution*, what is that temperature which she has pointed out as that which is most natural and therefore most healthy?

The temperature of the human body, in a healthy condition, is about 100 ° of Fahrenheit,—the blood of course about the same. According to my mind, then, it follows that that is the temperature *above* which, certainly, the air we inspire should not be raised. It may be *lower* because nature has provided a duct by which the air, in its passage to the lungs, may be *raised* to nearly the temperature of the blood before it reaches its destination, but the same duct would fail to *reduce* the temperature in the same proportion.

Dr. Roston, in considering the subject of animal heat, observes that, notwithstanding the constant uniformity of atmospheric air under all latitudes, with respect to chemical composition, its physical qualities are extremely variable. Cold renders the air more dense: the introduction of a greater quantity of this cold fluid into the lungs, stimulates the functions of these organs and also increases their capacity. By a contrary action—by reason of the respiration of a warm atmosphere—the chests of southern nations attain less expansion.

But every day's experience will be found as sure a guide in this matter, as we can have. We find that breathing warm air is generally debilitating, and breathing cold air invigorating. The fainting person will be restored by cool air, the healthy will become faint by breathing warm air. Cold air will check, if not prevent, the decomposition of animal and vegetable matter—warm or hot air will induce and facilitate it. I merely state these things as facts, without attempting to account for them physiologically; and this is sufficient for my purpose. Supposing, then, that the constituents of the air which we breathe be *pure*, its temperature, when higher than that of the blood, I believe to be unhealthy.

But although 100° be about the temperature of the human body, yet, strange as it may appear, we cannot in our climate comfortably exist with the temperature of our rooms, in winter, above 65° or 70° , and, as it follows of course, that we must breathe the same air in which we live, 70° or 80° is the maximum of the temperature of the air which we actually do inhale during this season of the year.

Nitrogen which forms four-fifths of the bulk of the air, never changes its form or character, oxygen does both, and that upon the slightest occasion, either by coming in contact with vegetable or animal matter, or heat or cold. When air is impure, it is wholly owing to the change in that constituent which, according to Mr. Jackson, is "the

principal element required for the breathing of animals and the life of plants," and, according to Dr. Lardner, "the life-giving principle,"—oxygen gas.

Now, no one who has paid attention to the hot air proceeding from the hot air furnaces constructed throughout the country, can have failed to notice its great heat. It may happen that, where the tin conductors are of considerable length, the air *entering the room* may be comparatively low in temperature, but its fall of temperature is no proof of its purity. If the oxygen has been injured or destroyed in the hot air chamber, it cannot be purified by becoming cool. I have never tried it, but I will venture to affirm that a thermometer placed in their hot air chambers will range in none of them less than 200° , and that in most cases the heat will go up to 400° ! Indeed, upon the principle upon which they go, of *heating the air that is in the room*, they are obliged to bring the air to this temperature or they could not produce the effect which they desire.

Let us, however, appeal to facts,—to the actual effects of this hot air system. There is not one person out of ten who, when first inhabiting or even going occasionally into a room heated in this way, who will not experience an oppression upon the head and a soreness, or perhaps it is better described as a dryness, in the throat, and other unusual and disagreeable sensations. Hang a cage of birds any where above the centre of the room and they will languish and die. Place green-house plants in the same position—they will wither and decay. The very flies will be exterminated. The destruction of the furniture is a matter of minor consideration, and indeed this evil is in some degree common with that of a stove heated apartment.

But it is said that a supply of vapour will resuscitate the air—will re-supply the place of the decomposed oxygen. This is an absurdity, for although the "life-giving principle" be destroyed, *for respiration*, mind, yet the *bulk* is still left, and it is as impossible to put two volumes

of air or gas into one as it is to put two bulks of marble in the place of one.

And if you attempt to supply a room with vapour, in any quantity you choose to designate, the consequence will be so great a diminution of oxygen gas, even supposing this last to remain uninjured, (which in the process under consideration it cannot,) that animal life could not be sustained. Water is composed of about two-thirds hydrogen and one-third oxygen. Now the space filled by vapour must of course be the measure of the *diminution* of atmospheric air, the composition of which is one-fifth oxygen and four-fifths nitrogen. It is evident, therefore, that under this process you lose the "life-giving principle" in proportion as nine to four. This is not all. Nature (to whom we must always appeal in order to test the truth of our philosophy) has ordained that the *residue* of the atmospheric air which we breathe shall be nitrogen, whereas in the case of mixing the burned air with vapour, this *residue* must be hydrogen. Now, all the gases have been divided into two classes,—the one, "respirable and capable of maintaining combustion," the other, "non-respirable and incapable of maintaining combustion." "Non-respirable gases are those which, when applied to the external organs of respiration stimulate the muscles of the epiglottis in such a manner as to keep it perfectly close on the glottis; thus preventing the smallest particle of gas from entering into the bronchia, in spite of voluntary exertion." The authority which I quote then goes on:—"Of the respirable gases, or those which are capable of being taken into the lungs by voluntary efforts, only one has the power of uniformly supporting life, namely, atmospheric air; *other gases, when respired, sooner or later impair the health of the human constitution, or perhaps occasion death, but in different modes.*"

I could go on and demonstrate by innumerable quotations from the most eminent medical men, that nothing but what nature's God has ordained for the support of

human life should be either eaten, drunken, or respired. I will add only two more with respect to the subject in hand, respiration. "Some gases effect no *positive change* in the blood; animals immersed in it die of a disease produced by the privation of atmospheric air, analogous to that occasioned by their submersion in water." Slower in its operation, however. "Others again produce *some positive change* in the blood, as appears from the experiments of Dr. Bedoes and Sir Humphrey Davy. They seem to render it incapable of supplying the nervous and muscular fibres with principles essential to sensibility and irritability. These gases, therefore, destroy animal life on a different principle." So that it appears that what of nature is once destroyed can never be supplied by the art of man; and that neither hydrogen nor any other gas than the two which constitute air can with safety be taken into the lungs.

Again, "the respiration of animals produces the same effect on atmospherical air as combustion does, and their constant heat seems to be an effect of the same nature. When an animal is included within a limited quantity of atmospheric air, *it dies as soon as the oxygen is consumed*; and no other air will maintain animal life but oxygen *or a mixture which naturally contains it*. Pure oxygen maintains the life of animals much longer than atmospherical air, bulk for bulk."

Once more, as it respects the consumption of oxygen gas by heat. Some substances have much greater affinity to, and consequently absorb oxygen gas more rapidly than other substances, *all*, however, absorb this material in proportion to their *temperature*. It is estimated that "charcoal will absorb nine times its own bulk of oxygen." This power of absorption is much increased when the charcoal is in a state of incandescence or burning, and instances of the death of persons shut up in rooms heated in this way, are, unfortunately, too common. The heating an unventilated room with a common fire, if it were possible to ex-

clude the smoke without leaving an aperture for its escape, would have the same effect, but less in degree; and the heat of a common stove or any other hot metal would produce the same effect, though it might take longer from the circumstance of the retarding effects produced by the absorption and radiation of the heat by the metal.

I have thought it necessary to dwell upon this part of the subject in order, if possible, to remove the strong prejudice I may call it, which has lately sprung up in favour of the use of that worse than useless succedaneum of pure oxygen, *vapour*, under a false impression that it resuscitates the injured air.

2nd. Hot air inventors appear to be ignorant of the expansibility of cold air by heat. The proof of this assertion will be given when we discuss the 4th error of these gentlemen.

3rd. That it circulates naturally by attraction only. Their error on this point also, I have thought it best to treat under the next, which is the

4th. Error of hot air inventors, viz: that cold air can be heated by hot air.

To heat cold air by hot air pre-supposes a *mixture*, or a *diffusion* of the hot air amongst the cold air. To shew the absurdity of such an attempt we will quote from Dr. Lardner, the properties of air. "Since air may be seen and felt—since it has colour and weight—and since it opposes resistance when acted upon, and strikes with a force proportionate with the speed of its motion—we can scarcely hesitate to admit that it has qualities which entitle it to be classed among material substances; but one other quality still remains to be noticed, which, perhaps, decides its title to materiality more unanswerably than any of the others. Air is impenetrable; it enjoys that peculiar property of matter by which *it refuses admission to any other body to the space it occupies, until it quit that space.*—This property air possesses as positively as adamant."

Now if air be thus impenetrable and refuses admission

to any other body, equally with adamant, I should like to know how these people expect to mix or diffuse hot air amongst cold air! The thing is impossible. The fact is they have succeeded in warming rooms exactly in proportion as they happened to be badly enclosed and open, where a small quantity of the air already in the room might, by *chance*, escape—and no further. They cannot *ventilate*, because like the stove-heated room, all the *heat* would escape, and their room left as cold as before, because as you have seen the hot air will always lie at the top.

With respect to the idea that hot air inventors have uniformly regarded the expansibility of air equal, or nearly equal, to that of water, is abundantly proved by the fact of their expecting to heat a building by the small quantity of cold air let into their hot air chambers, not exceeding in any one instance I think two square feet! and this too, professedly, merely *to give a draught to the heat!* whilst the fact is that water has fifteen hundred times the expansive property of the air!

Now if the air in a close room can neither be displaced or compressed by means of the hot air furnace, how is it that these “inventors” expect to heat a room which is full of cold air? The whole of their proceedings clearly shew that they imagine that they are heating the body of cold air *which is already in the room*; and that this is performed by means of a great heat communicated to a small quantity of air (say just sufficient to “create a good draught”) as effectually as if the same quantity of heat was imparted to a large quantity of air! They find too that they can heat an old and open house easier than a close one, but why, they cannot tell. In short they appear to have no notion of *expelling* the cold air at all. A few of them have lately, however, by some means or other imbibed a notion that *quantity* of air has somehow something to do with the heating of rooms; but how or in what way they seem at a loss to determine.

That the motion of air which we call wind is not the ef-

fect of any *propulsive* force, but caused entirely by the *attraction* caused by a sudden expansion or vacuum created, perhaps thousands of miles *ahead* of it, is familiar to every one. This is caused by nothing more than the ever-shifting temperature of the atmosphere; in consequence of which while the warm air rises here, there the colder sinks or rushes sidewise to supply the deficiency; in short, its motions are indescribably various, all in consequence of these changes of temperature. So that with the exception perhaps, of a slight deduction for its expansive quality, the air in its natural state moves from *attraction* only. Yet hot air "inventors" are every day attempting to *force* air into the buildings which they undertake to heat, when they ought to know that it can only be *attracted* there,—when they ought to know that the air already in the room is impenetrable, and when they ought to know that it is, for such purpose, incompressible. How they have succeeded, even as far as they have, will hereafter appear.

5th. That they do not understand that hot air is *lighter* than cold air, is evident from the fact that they studiously bring their hot air into the room through the *floor*, of course, supposing that they are thereby heating the lower part of the room first!

If this be not their object, I do not know what it can be; but so far from this being the case, the hot air keeps in a compact column, and the very first dispersion it is subject to is from the check given to its upward progress by the ceiling of the room; and they are as effectually heating the *tops* of the room first as if the air were brought in at that point.

Having already shewn the great error of hot air "inventors," who, from the beginning to the end of their practice, have so overheated the air as to injure, if not wholly destroy the "life-giving principle of the atmosphere, I need only further observe, generally, that the objections to this mode of heating dwellings are common to the *fire-place* and *stove*, with the exception of the cold draught to the feet; and I

must be permitted to repeat, (for it is all-important,) that if Mr. Jackson's assertion be true, that "oxygen gas is the essential and active part of pure air, and is the principal element required for the breathing of animals and the life of plants," then the hot air which is produced by the machinery at present in us, must more or less affect the lungs of every living being subject to its influence.

Down to the present time, most of those engaged in hot air operations, have gone on in total indifference to, and I charitably believe, ignorance of, the effects of the *quality* of the air introduced into their stove chamber; taking it indifferently from a kitchen or contaminated cellar, and in so small quantity that in order to accomplish their objects, even though the air happen to be pure, is necessarily destroyed by the excessive heat which they are obliged to impart to it. The oxygen gas (which is at the same time the life-giving and the heat-giving principle,) contained in air, forms only about one-fifth part of the whole body, and must, in undergoing this process, be decomposed, or at all events so far injured by the intense heat within the hot air chamber, that it must be unfit for respiration.

But, besides the evils which I have elsewhere enumerated, the column of burned air constantly oozing through the floor of the apartment, carries with it every particle of floating air in the apartment, in its turn, to the ceiling, and keeps the whole mass, saturated with an impalpable dust, in a constant state of ebullition, (similar to that of a boiling spring,) in a greater degree than a stove; and it is, in my opinion, taking it altogether, the most pernicious mode of heating a building ever adopted.

Having now, in rather a desultory manner, I admit, brought under your notice my opinions upon the necessity of an amelioration of our condition in regard to the warming of our dwellings and other buildings; and having also made objections to all the modes now in use, it, of course remains for me to lay before you my ideas as to what remedial measures ought to be adopted.

Before I do this, it is necessary that I should give you a right understanding of my views upon the influence which *climate* and *atmosphere* have upon our physical and moral constitution and powers.

After what we have heard, it is scarcely necessary for me to say that I intend to substitute, for the contaminated air in which we at present exist, a pure and unadulterated atmosphere. It will also be inferred from what has been said, that this can only be accomplished by means of a thorough ventilation of our dwellings with this material.

The difference in the *colour* of the inhabitants of Northern and Western and those of warmer climates, has long been a fruitful theme for speculation, but I am not aware that the difference in health and vigor of constitution has ever been accounted for. That there is a considerable difference, and that this difference is in favour of those of the temperate and colder regions, admits, in my opinion, no longer of a doubt.

It may not therefore, be out of place to mention the generally entertained idea, derived from History too, that no great *conquests* have ever been made by a southern over a northern people; but, on the contrary, the balance of victories has always been, or at all events terminated, in favour of the people from the colder climates. That such was the case in the olden time, the Biblical reader will find no difficulty in believing.

The *mind*, too, of man, there is no doubt, sympathises with the body. It cannot be disputed that, as a general characteristic, the people of the middle and northern nations of Europe and even America, are endowed with more vigor of mind as well as strength of body, than those of the southern.

As another coincidence of what I have stated with respect to the constitution of both mind and body of the inhabitants of cold countries, it may not be irrelevant to mention that the *language*, partaking, in its bold and distinct character of the physical formation of the organs, no

doubt, denotes a superiority, both in comprehensiveness and force, over the people inhabiting the more southern latitudes.

I will go one step further and venture to enquire whether, if it be shewn that monarchy is the general form of government in the northern hemisphere, and if it be proved that a monarchical form of *government*, be stronger and more vigorous than that of a *republic*, there may not be some weight, legitimately attached to the supposition that the body and mind of *nations*, if I may so speak, partake of the properties constituting the mass of the individuals composing that nation; thus completing the chain which binds together the whole moral, political, and physical world?

The *animals* of the Forests, certainly those which are domesticated, and which are common to both climates, are stronger and more vigorous in the north than the south.

Inanimate nature, too, it appears to me, is another proof of a coincidence in the comparison of the two climates which I have been making. Where can such *timber* be found in any warm country as that which abounds in the northern parts of Europe and America? Where the size, beauty and strength of the oak and pine, equal to that which grows in Norway and Canada?

This subject might be pursued with advantage by the politician, but my business is with domestic not political economy, and shall therefore leave the metaphysical disquisition which it invites to other hands. My purpose is merely to point at those facts in order that such inference may be drawn from the effects of climate, as the subject may warrant; and if I have succeeded in satisfying you that there is more health of body, vigour of mind, power of language, and strength of government, with the inhabitants of cold countries, than with those of the warmer climates, I do not see to what other cause you can attribute these peculiarities of character, than that to which I attribute

them, viz: *the effect of the purity of the atmosphere upon the constitution of man, in mind as well as body.*

Having been born in Canada, and having been for nearly half a century capable of making some observation, and latterly with minuteness, I could have no hesitation, should I be asked the question, in answering that there has, within that period, been an evident declension of health amongst the inhabitants, and, what I wish you particularly to observe, this declension of health is most conspicuous in, if not almost confined to, that part of the community whose avocations and situation compel them to lead sedentary lives, shut out from the pure atmosphere. This class of the community is composed of the artisans, mechanics, tradesmen, and the upper and more wealthy class, together with nearly all the females. That this portion of the community is less healthy than the farming or rural portion of *all countries*, I believe will generally be admitted, but I aver that the difference in health between the two classes is greater in this cold climate than it is in the more temperate climates, for instance, the British Isles. I believe too, that the difference here spoken of as existing between these two portions of the communities of all countries, is attributable, mainly, to the deprivation of pure air, for respiration, on the part of those who are for the greater part of their time shut up in artificially heated buildings. If this be true, it follows of course, that this cause must operate more injuriously in this country, where a very great degree of artificial heat is required to be kept up for six or seven months in the year, than in the old countries, where but a very moderate artificial warmth is required for two or three months only. And it cannot, I am afraid, be denied that, notwithstanding the superiority of our climate, the people, generally, from Great Britain and Ireland, are more rugged, robust, as they certainly are more ruddy—take them class for class—than those of the northern and more cold climate of America. The reason of this is, to me obvious enough, there they take more out-door exercise and air,

and are subject to much less confinement amongst the dust of stove rooms and other artificially heated apartments. Indeed, it may be said that fire in any shape, even in winter, there, is the exception instead of the rule, but here, we are obliged to keep it up during six, seven, and sometimes eight months out of the twelve! Hence it is that old countrymen stand our climate even better than we do, for the first few years. *Our dwellings during a Canadian winter, are oppressively hot to an old country emigrant,—theirs, to a Canadian, are always uncomfortably cold.*

It is clear to me then that this difference in health is solely owing to the circumstance of the one breathing a pure, unadulterated air for the greater part of the year, whilst the other is shut up in a contaminated atmosphere during the same period. The people of Great Britain and Ireland are, moreover, accustomed to living in a temperature of from 15° to 20° lower in winter and summer than Canadians; and the latter, in order to guard against the great vicissitudes of temperature, (ranging at times between 30° and 40° below zero in winter, up to 100° in summer,) are obliged to submit to being overheated whenever the thermometer rises, these alternations being so frequent and uncertain, in winter especially, as to render it impossible effectually to guard against them, either in our dwellings or clothing.

You will, of course, have anticipated my opinion upon the influence of climate upon the physical and moral constitution of man.

1st. That the coldest climate is the most conducive to health and vigour of constitution, and, as a consequence, strength of mind.

2nd. That a hot climate is the most enervating to both mind and body.

3rd. That a temperate climate partakes of the nature of each in proportion as it approaches in degree toward either.

Since I have given an opinion that old country people are more healthy and robust than Canadians, it might, without explanation, be charged to me as an inconsistency in here putting down the coldest as a more healthy climate than a temperate one. When we speak of climates we must of course mean their *natural* state, because they cannot be altered by artificial means. But I speak of the inhabitants residing within these climates as in their *artificial* state. It is not the fault of our climate that we shut it out of our dwellings and create an artificial one, about two-thirds of the days in the year, and two-thirds of the hours of every such day; and destroy by means of stoves and hot air machines, even that little which (fortunately for us,) *forces* itself into our dwellings.

It is not denied by any one, I believe, that the rural and out-door labouring portion of the population of all countries, is the most healthy. The cause of this has been, and I believe, is now, generally attributed to physical exertion. My opinion is, that labour has nothing further to do with the maintenance of health than as it tends to the extraordinary and frequent expansion of the cavity of the chest, by the action of the muscles from bodily exertion,* by which means a much greater quantity of air is brought in contact with the blood. Health is never, otherwise, dependent upon bodily exertion, though bodily exertion is always dependent upon health.

But we will see what evidence we can find in corroboration of my theory : and the witnesses which I shall sum-

* Since the above was written, I have been favoured by a friend with the perusal of Dr. Fitch's Lectures. In the one on the "Uses of the Lungs," is the following remark :—

"Another striking instance," he says, "is the use of the right arm. It is seen with all the natives of this Globe, that the right arm is preferred in its use over the left ; in other words, that all men are right-handed, as a general rule. Some very unsatisfactory reasons are given for this. The true reason is found in the fact, that the lungs give us the power of action, and that the right lung is larger than the left ; hence it gives more power to the right arm. I have often seen the right arm hang quite useless at the side by extensive disease of right lung."

mon will be none the less credible because they are unwilling, or at least, unintentional witnesses.

A. Quetelet, perpetual secretary to the Royal Academy of Brussels, in his dissertation on Man, and the development of his faculties, says, that the influence of disturbing causes on the number of deaths are—professions, morality, intelligence, and political and religious institutions. Statisticians, he says, have already proved that the mortality in manufacturing districts is greater than that in agricultural; and greater also in towns than in rural districts. Wealth, or at least, competence, is also ascertained to be more favourable to longevity than poverty. Among negroes who are slaves, the annual mortality is 1 in 5 or 6, while among negroes serving in the British army it is only 1 in 33.

Again, the same author says,—It would appear that both in northern and southern countries the rate of mortality is greater than in temperate regions. The mortality is also greater in towns than in country districts.

Dividing Europe into three regions, North, Middle, and South, M. Quetelet considers the rate of mortality to be as follows:

North, 1 in 41.
Middle, 1 in 40.
South, 1 in 33.

The lowest rate of mortality, he says, occurs in England, it being only 1 in 51; and the highest in Russia, 1 in 21. If England be excluded from the calculation, the central part of Europe will still exhibit the smallest portion of deaths.

He then gives the rate of mortality in situations nearer the equinoctial line, thus:

S. Lat.	6 ° Batavia,	1 in 26.
N. Lat.	10 ° Trinidad,	1 in 27.
"	14 ° Martinique,	1 in 28.
"	15 ° Gaudaloupe,	1 in 27.
"	18 ° Bombay,	1 in 30.
S. Lat.	20 ° Isle Bourbon,	1 in 44.

~~N. Lat.~~ 23 ° Havana, 1 in 33.

~~S. Lat.~~ 34 ° Cape of Good Hope, 1 in 51.

Thus showing that within the range of 28 °, near the equator, the difference is nearly two to one against the hot climate. Yet this excites no wonder in, or elicits remark either from the author or his commentator! Now if my principle be applied to this, as in all the other cases, the solution becomes easy.

Although the atmosphere possesses the same constituents and in the same proportions, and is equally pure in all climates, yet, says Professor Foissac, "in warm climates the air being rarer and more expanded, the lungs absorb less oxygen,—the proportions of the venous system will thus preponderate over those of the arterial, &c." Now this direct testimony coupled with one from Professor Leibeg will be conclusive as to the cause of disease in warm climates, viz: the want of a supply of "oxygen" for the lungs, and not, as is generally supposed, cutaneous transpiration, and the action of heat upon the head and surface of the body.

This gentleman, after demonstrating that all animal as well as vegetable substances are in a constant state of decay, says, "The greatest wonder in the living organism, is the fact that an unfathomable wisdom has made the cause of continual decomposition or destruction, (namely, the support of the process of respiration,) to be the means of renewing the organism, and of resisting all the other atmospheric influences, such as those of moisture and change of temperature."

M. Quetelet next gives a table which exhibits the influence of *seasons* on mortality. It is too long to copy, but the result is, that the deaths, in the winter months, taking all Europe, are as 5 to 4 in summer. Upon which he remarks that "the fewest deaths take place at that period of the year when men have least to fear from the inclemency of the weather." Professor Foissac corroborates this. "From the researches of statistical writers it ap-

pears that all over Europe the maximum of deaths occurs toward the close of winter, and the minimum toward the close of summer." These are, in my opinion, clear proof that disease is both engendered and also rendered more virulent whenever, from the inclemency of the weather or any other cause, we are shut out from a pure atmosphere.

It is remarkable that whilst all these staticians agree in their general *facts*, only one has had a glimpse of the right cause, and only upon that of the hot climate. The number of deaths in the temperate and colder climates keep pace exactly with the length of time the inhabitants are shut up in their dwellings, breathing an impure atmosphere. Nothing can place this view in a stronger light than the fact that the English, who are scarcely ever subjected to artificial heat, lose but 1 in 51, whilst the Russians, who are necessarily compelled to live much the greater part of their time excluded from their natural atmosphere, lose 1 in 21, or more than double that number, by death.

Lord Bacon, says the Right Honourable Sir John Sinclair, seems to have been the first who, by a careful and minute inquiry into the duration of the lives both of man and a number of different animals, established the principle, that longevity is in proportion to the slowness with which the animal reaches maturity. This, indeed, is the case in the vegetable as well as the animal kingdom. It is owing to this circumstance that people in cold countries, (he means England,) and whose growth is not accelerated by enriching food or early debauchery, live much longer than natives of warm countries, who are reared, as it were, in a hot bed, and who are full grown men and women at twelve years of age.

I believe that the longest lived animals, and those longest in coming to maturity, are *man* and the *eagle*. It is certain that these have the largest lungs, in proportion to their bulk, of any part of creation. Is it unreasonable then to infer that length of life depends upon the *quantity* of air

consumed, as also its *purity*? It strikes me, therefore, that whilst Lord Bacon has hit upon the *effect* he has mistaken the *cause*.

The following table is quoted from *Casper*, on the expectancy of life in different *professions*.

THE NUMBER OF 100 WHO REACH 70 YEARS OF AGE.

Theologians,	42.
Agriculturists,	40.
Superior Clerks,	35.
Merchants and Manufacturers,	35.
Military men,	32.
Inferior Clerks,	32.
Advocates,	29.
Artists,	28.
Teachers and Professors,	27.
Medical men,	24.

M. Quetelet remarks upon this table of mortality, that it would appear that mental occupation is more prejudicial to life than bodily fatigue; that the most favorable to longevity is a sedentary life not exposed to any excess; and that the most unfavorable is that in which mental and bodily exertion are combined.

We have already dealt with agriculturists; no one disputes that theirs is a profession most favourable to health. Let us now contrast with each other, the three highest classes with the three lowest, except Physicians, on the list. Theologians, Superior Clerks, and Merchants and Manufacturers, on the one hand, and Advocates, Artists, and Teachers and Professors, on the other. Now I think it impossible, upon any correct principle, to assign or attribute this remarkable disparity of age to the difference in mental occupation alone. There must be some cause assigned other than that which is given by the author, viz: mental occupation. This omission I think I can supply.

The Churches, on the continent of Europe especially, are very high in the ceiling, and being only occasionally

occupied, and that for a short period, it may be taken for granted, that the air within them is always, at the commencement of the service at any rate, nearly as pure as the external atmosphere; besides, the dust may be supposed to be settled, nor is it brought to that state of ebullition which the introduction of artificial heat invariably produces.* In this building a clergyman speaks to a

* Let any one who doubts that heat will affect air in the same way as it will water, try the experiment by causing tobacco to be smoked in a house in which there is no heat, and then again when the building is heated; in the first case you will scarcely perceive it in the next room, nor then until the lapse of considerable time, while in a warmed building it will be perceived over every part, even to the 2nd or 3rd stories, almost immediately. The fact is, that air boils the same as water, and the state of ebullition is increased with the increase of the heat.

And this, I have no doubt, is the reason why all epidemics and contagious diseases are more general and more fatally virulent in warm than in cold countries, and in summer than in winter. The whole atmosphere is then in a state of ebullition, and the miasm which at the beginning is so exceedingly minute and subtle, by motion and contact with the air causes the latter to assume a state of *fermentation*, until a whole land becomes covered and impregnated. I will give one proof out of a thousand in corroboration of this fact:

In ancient Egypt, says Mr. Walker, the plague was unknown. Although densely populated, the health of the inhabitants was preserved by strict attention to sanitary regulations. But with time came on change,—and that change was in man. The serene climate, the enriching river, the fruitful soil remained; but when the experience of 2000 years was set at nought,—when the precautions previously adopted for preserving the soil from accumulated impurities were neglected,—when the sepulchral rites of civilized Egypt were exchanged for the modern but barbarous practices of interment,—when the land of mummies became, as it now is, one vast charnel,—the seed which was sown brought forth its bitter fruit, and from dangerous innovations came the most deadly pestilence. The plague first appeared in Egypt in the year 542, two hundred years after the change had been made from the ancient to the modern mode of sepulture; and every one at all acquainted with the actual condition of Egypt will at once recognise in the soil more than sufficient to account for the dreadful malady which constantly afflicts the people.

But of the spread of diseases we have had quite sufficient proof in these Provinces during the cholera time in 1832 and 1834, as well as the typhus fever by the emigrants of last year. And we may expect a repetition of these evils until ship-owners shall be obliged to properly ventilate their ships. The carrying out of our present sanitary regulations only lead to the sacrifice of life, time, and money. I have the utmost confidence in my assertion when I say, that if I were allowed to ventilate an emigrant ship, not a single person on board would die of an infectious disease, in crossing the Atlantic ocean.

congregation for an hour or two, perhaps every day in the week. It is clear then that this uniform exertion of the lungs,—speaking at the top of his voice, as he generally does,—this practice being continued for years, must induce an enlargement of the cavity of the chest, as well as a tension in the lungs, which operates to keep them in a healthy condition. In consequence whereof, there cannot be a doubt, a much greater quantity of oxygen must be communicated to the blood. Clergymen, too, if they be active and useful men are frequently out in the open air. Superior Clerks, Merchants and Manufacturers, M. Que-telet classes with Theologians, as being the longest lived. Now I deny that there is any comparison between these as to mental occupation, especially between Superior Clerks and Clergymen, and yet his own table exhibits a preponderance in longevity of one-sixth in favour of the latter.

This table also makes a difference of 50 per cent of deaths against Advocates, Artists, Teachers and Professors, and as between Theologians and Teachers and Professors, who, as it regards mental occupation, were about on the same footing, whilst it makes 42 of the former live to 70, allows only 27 of the latter to attain to that age? We are compelled therefore, to seek for some other cause for this disparity in mortality than that given by the statician, viz. mental occupation.

We will now try the pure air principle. It is well known that Advocates, Artists, Teachers and Professors, are scarcely ever outside a building, except during the time they are going from one to another. It is true indeed that as it respects Advocates, they are public speakers; but mark the disadvantageous difference between one of this profession and the Clergyman. Whilst the one is speaking in a cool, pure and comparatively unadulterated atmosphere; the other is in a crowded court room, enveloped in dust and breathing an atmosphere up to 80 ° or

90 °, and saturated with the expired putridity of hundreds of pairs of lungs ! *

Artists, Teachers and Professors, from their sedentary habits necessarily require, almost always, artificial heat ; and as it respects Teachers and Professors especially, they are, perhaps, as much subject to breathing an impure air as Advocates.

For these reasons chiefly, it is, in my opinion, that the mortality in these professions is so much greater than that amongst Theologians.

I am, however, not willing to be understood as denying that the health of individuals may be affected by mental occupation ; I believe it often is ; and I am willing too to admit that although the minds of the clergy may be as incessantly engaged as those of some of the other professions named, yet it is not of that wearing and harrassing character, which Teachers and Advocates are obliged to contend with.

With respect to clergymen in particular, and indeed all truly religious men, it may be observed that by their habitual contemplation of the Deity and his works, and by their habitual occupation, their minds become school'd as it were, into an equanimity and complacency which those of others are not. "Great peace have they who love thy law and nothing shall offend them." Hence it is that Clergymen and Judges are so remarkable for longevity ; whilst you seldom hear of an instance amongst those whose avocations are of a harrassing nature or who are known to have been of an habitually, choleric, irritable and irascible temperament, living to any very great age ; these forget, or perhaps have never heard that "Better is he that ruleth his spirit than he that taketh a city."

No triumph can be greater than that of a resolute man

* It is impossible for us, says Dr. Arnott, not to be struck with the culpable carelessness—in cities, especially in assemblies of every variety—not only are the audiences subjected to extreme uneasiness, but the tone, the mental faculties both of audience and speaker incapacitated and affected by the state of the atmosphere in the room.

over his passions. And this triumph greatly contributes to lengthen his days.

"I cannot pass over," says Dr. Fitch, "the vast importance to health, that the mind, in all its parts, should be well balanced—no one attribute of mind acting at the expense of the other. A disordered and distempered mind is totally incompatible with health and long life. It soon destroys the body of its possessor. Tranquility and repose of mind are indispensable to health and long life.

Sir John Sinclair, in quoting from a correspondent, says, "Of the power of the mind over body, I have seen some striking instances, and can safely affirm that mental agitation is a strong predisposing cause of disease. I lost two friends some years ago in fevers, the origin and progress of whose complaints I knew and carefully watched. One was a physician of a very strong and robust habit of body, but whose mind having been dreadfully agitated by a particular vexation, he caught a low typhus fever in visiting a poor patient, and sunk under it. The other was a gentleman of great delicacy of sentiment, and who was cruelly harrassed by the brutal behaviour of a partner in business. He took a typhus, though no cause of infection could be traced, and fell a victim to it. I am satisfied that the actual cause of the death of both was mental agitation.

Of the effects of the violent and distressing passions, and of the pleasing emotions of the mind upon health, there is but one opinion in the whole medical world, and therefore it is only necessary here generally to refer to the subject. Sir John Sinclair's "Code of health and longevity" should be in the hands of every person. And how does this great philosopher sum up his "Rules for the preservation of life?"

1st. BREATHE PURE AIR; 2, Use a moderate portion of liquid food; 3, Consume no more solid food than the stomach can easily subdue; 4, Preserve the organs of digestion in good order; 5, Take regular exercise without over

fatigue ; 6, Sleep as many hours only as may be necessary to restore the strength of the body and mind ; 7, *Control the passions and bear with fortitude the disappointments of life.* These are the most effectual means of preserving health, of enjoying life, and of attaining longevity.

I leave it to the experience of every man or woman of observation what proportion of this health of body and mind is contributed *by breathing of a pure atmosphere alone.*

Notwithstanding however that I am willing to make great allowance for the influence of mental occupation upon the lives of individuals, I cannot go to the extent to which it is carried by the author of the table which I have quoted.

Of Medical men, which this table places at the foot of the list, I have as yet said nothing. At a first view, this class of men should live as long as other people ; for they certainly are not less exposed to the open air than clergy-men, or in fact any of the others. The table however allows only 24 of them to reach 70 years whilst it allows 42 Theologians to live to that period—thus making the mortality of the former, within a fraction of, double that of the latter. It can easily be understood that the mental occupation of the physician is greater than that of any of the other professions, yet we can hardly attribute this immense difference of mortality to that cause alone. It is my opinion therefore, and this table is another proof of its correctness, that we have no more natural cause to which to ascribe it than to the miasm of the sick room. When we come to consider this subject of miasm more at large we will then be enabled to judge of the effect which it is likely to produce generally. As applicable here it may not be improper to quote from Professor Leibeg—"When the functions of the organs of secretion are impeded, foreign substances will remain in the blood, or become accumulated in particular parts of the body. The skin, lungs and other organs, assume the functions of the diseased se-

creting organs, and the accumulated substances are eliminated by them. If, when thus inhaled, they happen to be in a state of progressive transformation, these substances are contagious, that is, they are able to produce the same state of disease in another healthy organism." Again, "Ammonia is very generally produced in cases of disease; it is *always* emitted in those in which contagion is generated, and is an invariable product of the decomposition of of animal matter. The presence of ammonia in the air of chambers in which diseased patients lie, particularly those affected with a contagious disease may be readily detected." "Cold meat," he says, "is always in a state of decomposition; it is possible that this state may be communicated to the system of a feeble individual, and may be one of the sources of consumption." Now if the "exhalation" from cold meat is sufficient to communicate disease in "an healthy organism" can a doubt remain that the miasm of a sick room will much more communicate disease?

But as examples recent and near home have generally a more powerful effect I take the following deductions from enquiries instituted by Drs. Cusack and Stokes which present a lamentable picture of mortality among the physicians in Ireland, during last year's sickness in that afflicted country.

"1. That the physicians and surgeons of Ireland are, by their profession, more exposed to the influence of fatal disease than any other class of the community of a similar grade; and that they are at all times liable to these influences, from the period of their entering the profession as students to advanced life.—2. That few, if any of the medical profession in Ireland escape typhus fever; that many have had it twice, and several three times.—3. That the fevers of medical men in Ireland are almost always of a bad character, even when the epidemic is not of the worst kind; and that consequently, fever has proved more fatal to medical men than to any other class of the com-

munity of a similar grade in this country.—4. That the fevers and other infectious diseases, from which our profession suffers so severely, are generally contracted in discharge of public duties, either in attendance upon sanitary institutions, or in the miserable, ill-ventilated, and dirty dwellings of the poor.—5. That, according to our returns received for the period prior to 1843—undoubtedly deficient—568 out of 1,220 practitioners, in charge of medical institutions suffered from typhs fever; of these twenty-eight had fever twice, and nine three times; and that of the whole number, three hundred, or one-fourth, died.—6. That the calculation contained in the papers which we have now laid before the public, show that, of 743 deaths of medical men, of which we possess the particulars, 331 were caused by typhus fever, or 1 in every 2.24—nearly 45 per cent. of the whole.—7. That, during the prevalence of the late epidemic, 500 Irish medical men, at the lowest computation, suffered from fever or other epidemic diseases, contracted, for the most part, in discharge of public duties, by which themselves and their families suffered considerable loss.—8. That about one-fifteenth of the entire medical community of Ireland have died during the year 1847.—9. That during the continuance of an attack of fever, and in cases of recovery, for a long period subsequent to it, the families of medical men are deprived of their exertions—usually their only means of support. We think that as the risk incurred in the public medical service in Ireland is so great, an adequate remuneration should be afforded for the performance of these services; and as the widows and children of medical men who have died during the last two years have been, in many instances, left totally unprovided for, we most earnestly recommend to the consideration of the government the propriety of making some legal provision for the families of those gentlemen whose lives have been sacrificed to the public service.”

The deaths among the physicians and clergy of Que-

bec during the fever at Gross Isle amongst the emigrants, as well as of that philanthopist Colonel Calvert who died in making his experiments with M. Le Doyen's disinfecting fluid, ought of themselves to be sufficient proof of the fatal effects of miasm. I have been lately informed by Mr. Campbell, a gentleman of science and high standing in Quebec, that all the *habitants* who purchased bed, and other cloths, from the emigrants, died—that every one of the workmen who was employed in the construction of appertures on the tops of the sheds for ventillation took the fever and most of them died. This gentleman also says that a much greater proportion of the inhabitants and emigrants in the *lower* town of Quebec died, than of those in the upper Town. A striking proof of the theory, now generally admitted to be correct, that miasm is specifically heavier than, and *sinks* in, the common atmosphere.

But this, it may be said, is *typhus* fever, which every one knows to be contagious. Very true, so are all other fevers contagious, not perhaps so certainly or so virulent in character, but that the miasm of the sick room, whatever may be the ailment may communicate disease to weakly constitutions, no one can doubt. It is true that the naturally strong constitutions and healthy organism of some, may, and frequently do withstand the immediate effects of miasm. It is a frequent occurrence that children of a large family as well as adult persons, escape the Small pox, Whooping cough, Measles, Scarletina, and the whole catalogue of infectious diseases, whilst all the other members take them. These are the *exceptions*, the *rule* is otherwise.

From these facts may be gathered some idea of the perils which medical men are obliged to encounter; and whose devotion to their duties afford ample proof how much that noble profession, whilst it stands at the head of all others for usefulness, also serves to elevate the *man* and constitute the *philanthropist*.

If then I am borne out in my theory that the health of so large a proportion of the inhabitants of the colder regions of America as is comprised in the class which I have mentioned, is affected by the deprivation of pure air to supply the lungs—the question is what is the remedy for this state of things? I answer—if from any cause you cannot bring these people into a pure atmosphere *you must bring the pure atmosphere to them.* You must cause the *inside* of your building to resemble as much as possible (except the temperature in winter) the *outside.* Pure air you *must* have in one way or another; without it, no earthly power can preserve your health. *Therefore a thorough—a constant day and night ventilation is the only remedy we have.*

Upon the necessity of a supply of oxygen to the lungs I shall make one extract out of a thousand: "Unless sufficient oxygen be supplied to the lungs by daily exercise in the open air, the products of decomposition will fail to be removed, in sufficient quantity for the maintenance of a healthy state." "When the system, therefore, undebilitated by disease, will admit a good supply of oxygen by muscular exercise, it is the best means of diminishing the amount of venous blood, and (in conjunction with a legitimate supply of proper food) of increasing the amount of arterial blood; and in proportion as the latter preponderates over the former, shall we possess health and muscular strength, as well as elasticity of mind."

But we have no occasion to go to books for advice upon this subject. We have thank God as yet within the British dominions, a host of scientific men whose business and I will add *duty* it is to watch over the health of the people. And it is here worthy of remark that, whilst hundreds and thousands of quacks and empyrics are daily practising and fattening upon the credulity of the people of Europe and America, and by the administration of their nostrums, laying the foundation of disease and death which must inevitably be visited upon the children's children of

such as suffer themselves to be misled by them, for generations to come, not one, so far as my knowledge extends, has ever advised his patient "a change of air"—whilst the scientific and regularly bred physician, makes it his first business to enforce upon the attendant of his patient if he be unable to go out—a thorough ventilation of the sick chamber; and to the debilitated—whether in mind or body, his first advice is "get into pure air."

If it were for nothing else, I should honor the science of medicine for this cardinal trait in its practice; which, even at a pecuniary sacrifice of the practitioner, enjoins upon its disciples and followers, the obligation which if they are conscientious men they dare not violate, to enforce this all-important remedial agent—"purity of air."

It must be admitted that we cannot judge either by *hearing, seeing, feeling, smelling, or tasting*, what may be healthful for us; and hence we are *compelled* from our infancy to defer to others whose experience in those matters render them qualified to advise us. If we wanted a horse shod we would not go to a joiner; nor would we go to a shoemaker to mend a clock, but we should apply to those whose experience and education we knew qualified them to perform our work. In the matter of health our external senses, as I have repeatedly said, are not safe guides. With what caution do we taste of any vegetable which is new to us? Children will not, of their own accord, eat what they never have before seen. The dumb brute, being incapable of receiving *reasonable* instruction, is supplied by the Allwise Creator with an instinct which stands instead of reason (the faculty given to man) and prevents him from eating a poisonous herb. Why not then in the all-important matter of health take, and follow, the advice of those who, I have no doubt, are the appointed ministers "for this very purpose?"

LECTURE II.

In the Lecture of last evening I endeavored, 1st. To bring under review the situation and prospects of Canada in regard to fuel. 2d. To shew how inadequate were our external senses alone to guard us against the many evils to which we are daily subjected. 3d. To compare and estimate the value of the different modes of heating buildings at present in use. 4th. To set forth and correct the errors of hot air inventors. And 5th. To draw a comparison between the different climates and the different classes in each climate as it respects health.

I intend at this time to describe some of the properties and attributes of air as well as the quantity required for respiration and ventilation. 2d. The chemical effects of miasm. 3d. To suggest some alteration in the construction of our dwellings. 4th. To show the true philosophical principles of ventilation. 5th. The erroneous system of ventilation in Great Britain. 6th. The evil effects of our present habits and mode of living; and lastly, to give an opinion, with my reasons, that the proper ventilation of our dwellings will *prevent* most of the diseases to which we are subject, and especially consumption.

Since, then "*pure air*" is that, and that only which the Almighty has provided for our use—and since it is the foundation upon which the science of medicine predicates the recovery of the sick—we must in the first place enquire what pure air is; and secondly how much we require for use.

Besides what I have quoted upon the properties of air from Mr. Jackson, Dr. Lardner says, "The atmosphere is a thin transparent fluid, which surrounds the earth to a

considerable height above its surface, and which in virtue of one of its constituent elements, oxygen gas, supports animal life by respiration, and is necessary also to the due exercise of the vegetable functions."

Mr. Jackson, of Edinburgh, says, "The atmosphere is an invisible acreform fluid which wraps the whole earth round to an elevation of about forty-five miles above the highest mountains. This great ocean of air, as we may call it, is far from being of a uniform density throughout its mass. At and near the level of the sea it is most dense, in consequence of the pressure above. As we ascend mountains, or in any other way penetrate upwards, the air becomes gradually less dense; and so thin is it at the height of three miles, as for instance at the summit of Mont Blanc, one of the Alps, that breathing is there performed with some difficulty. Beyond this limited height, the density of the air continues to diminish; and at the elevation of about forty-five miles, is believed to terminate. So dense are the lower, in proportion to the higher regions, that one half of the entire body of air is below a height of three miles—the other half being expanded into a volume of upward of forty miles."

So important an element as that which the Almighty has designed for the sustentation of all his animal and vegetable creation, is not left without means for its own purification. Mr. Jackson says, that "The constant preservation of atmospheric purity is one of the greatest phenomena in nature. The purification is effected by divers processes—as, by winds; by the vast extent of ocean over whose surface is an inexhaustible reservoir of pure air; by electric agency, but chiefly by the solar rays."

Now, it appears to me, that unless we by some means attain a system by which we can be supplied within our dwellings, constantly, night and day, whether sleeping or waking, with this fluid in its original and pure state, we cannot, and indeed ought not, to reasonably expect either health of mind or body.

Now let us enquire *how much* of this "fluid" is required.

Dr. Thompson thinks that "We should not be far from the truth in supposing that the ordinary quantity of air contained in the lungs is 280 cubic inches, and that there enter and go out at each inspiration and expiration, 40 inches. Thus, supposing 20 inspirations in a minute, the quantity of air that would enter and pass out in this time would be 800 inches; which makes 48,000 in the hour, and in 24 hours 1,152,000, cubic inches" equal to 666 cubic feet!

You will please recollect that only one-fifth part of the air is the "life giving principle" oxygen gas—the other four-fifths—nitrogen, being a mere "diluent to correct the strength of the oxygen." It follows, of course, that if a person inspires, during 24 hours, 1,152,000 cubic inches of air, he *destroys* 230,200 cubic inches of oxygen. I say destroys, because, as you will remember, the lungs absorb and the blood retains *the whole of the oxygen* and sends forth in its stead nitrogen or azote, as it is sometimes called. A room 20 feet square and 10 feet high contains 6,912,000 cubic inches of air; so that one person confined in a perfectly air tight apartment of that capacity would live just six days and no longer, or six people would consume it in one day and then die.

We have no alternative then, but to so construct our dwellings that this unadulterated fluid shall constantly circulate through every room in such volume as shall not only supply the respiratory organs of the inmates at every breath they draw, but also be sufficient to carry off, as a disinfecter, all the putridity caused by combustion of the lungs, cutaneous transpiration and otherwise incident to every dwelling. *And this is the whole object of my enquiry, and the desideratum which I have both experimentally and practically attained.*

It is no easy matter I know for us to entirely divest ourselves of preconceived notions which may have grown into prejudices, but I must in this instance request you to

go along with me in discarding for the time the terms "heating or warming buildings" as conveying a wrong idea, and to adopt in its stead the word *ventilating*. For these purposes let us suppose that we are living in a temperate climate where no artificial warmth is required; because the ventilating of buildings depends not at all upon the temperature of the air—whether it be hot or cold the same process is as necessary in one climate as another—in a Canadian winter as in a Canadian summer, in the frigid as in the temperate and torrid zones. I do not intend to *heat* your building at all even in winter; all I intend to do is to ventilate it—with warmed air in winter and cooled air in summer. For this purpose I intend to erect apparatus outside of your building by which means I shall cause a volume of air, according to the size of the building—(say for one of 40 feet square and two or three stories high—at the rate of 50 square feet per second) to circulate through your house night and day, the year round. (The article you know is cheap—the Almighty has given it to us for this more than any other purpose.) Then by the erection of metal machinery intercepting this trunk of air at some convenient point before it be dispersed throughout the building, and so constructing it as that by heating, it will bring this volume of air to such temperature as may be required—your dwelling will in winter be *warmed* as well as ventilated. This is all.

Now if it be objected that the distinction which I make between *warmed* air and *heated* air is without a difference I have only to answer that the difference is about the same as it would be for a person to take a dose of *laudanum* every night to induce sleep instead of daily and healthy exercise.

I must repeat to you that we have entirely thrown overboard the term "heating" and turned our undivided attention to *ventilating*. Then we must suppose that a volume of pure air admitted by an aperture of nine or ten square feet at a velocity of five feet per second is ready to

enter the hall of your house, constantly—in winter raised (by a fire to be kept in the metal machine) to a temperature of about 100° Fahrenheit, and in hot weather (by the air being brought under or near the ground) at a temperature of about 70° .

Before I proceed it is further necessary for me to remind you of two things, which it is important in the further discussion of this process, should be constantly borne in mind—1st. That warm air is lighter than cold air and will *always* be found at the *top*—2d. That air whether warm or cold is impenetrable; and for all practical purposes in our process—incompressible.

Mr. Jackson says "The more heated any fluid becomes, it is the more expanded, and consequently lighter. Being lighter, it rises or mounts upward, while the colder fluid sinks and occupies its place to be warmed and lightened in its turn."

But to convince ourselves of this fact we have only to get up close to the ceiling of any artificially heated room; or open a door between a cold room and a heated one both rooms will become cold at bottom and warm at top; and as further proof, whilst this change is going on, hold a candle near the top of the opening and set another at the bottom, the one will draw *into* the cold room the other *out* of it. Indeed you cannot compel cold air and hot air to become blended or mixed, by whatever means or however you may disturb it—the moment the agitation ceases the warmest will be found at the top and the coldest at the bottom.

With respect to the impenetrability of air Dr. Lardner says "Since air may be seen and felt—since it has colour and weight—and since it opposes resistance when acted upon, and strikes with a force in proportion to the speed of its motion—we can scarcely hesitate to admit that it has qualities which entitle it to be classed among material substances; but one other quality still remains to be noticed, which perhaps decides its materiality more unan-

swerably than any of the others. Air is impenetrable ; it enjoys that peculiar property of matter by which *it refuses admission to any other body to the space it occupies, until it quit that space.* This property air possesses as positively as adamant."

The mere gratification of our sense of feeling, by raising the temperature of our dwellings, although, I admit, a matter of necessity at certain seasons of the year in cold climates, is yet but of secondary importance ; our primary object should be a full supply to the lungs of the inmates, with that material which the God of nature has ordained for that purpose—pure air. Our second object should be *the purifying of our dwellings* by that universal disinfectant—pure air. If we would but follow out nature as she points the way, we could never err in the application of those things which she so bountifully supplies for our physical wants. But no, we oppose stone and brick walls to her—we shut her out, and yet we expect her to follow and *force* upon us her bountiful gifts ! We every day hear of this disinfecting fluid and that disinfecting nostrum. We have become so wise that we can supply nature's deficiencies and perfect her work !

This reminds me of the New Englanders who, in their haste after the breaking out of the rebellion in the old colonies, had forgotten to substitute other laws, in place of those of the mother country which they had most patriotically denounced, blown up and exploded—meeting for the purpose of supplying the deficiency, and finding it a *rather* more difficult matter than they had anticipated—after a long consultation, concluded for the present to adopt the laws of God, until a respite from their military duties should give them leisure to make better !

If we but reflect upon the amount of putrefaction that has gone on for six thousand years—and is now going on—from the hundreds of millions of human beings, and thousands of millions of other animals—added to that of the whole vegetable creation, and consider that the atmosphere

is as pure now as it was at the beginning—we shall at once be convinced that this must be a disinfector of *rather* greater power than “chloride of lime!”

With a proper supply of pure air—pure water—a poor but clean cook *and no carpets, brooms or dusting brushes*, we may defy the world and all the Doctors.

Before we proceed to set in motion our ventilating process, we must first erect a building for the purpose, or prepare one that is already erected.

It is here worthy of remark, that the ventilating of buildings has hitherto, I believe, formed no part of the calculations of the architect, or if it have—it has generally proved to be inoperative during the winter season in Canada. This defect in our system of building has arisen, no doubt, from the known impossibility of allowing the air to escape from the top of a room without at the same time losing the warmth, and rightly concluding that a circulation of the air in its naturally cold state in winter would render any room uninhabitable. It is true that we all *talk* of ventilation as if it were a common matter, and some architects with more assurance than brains would be offended if any should presume to question their ability in this matter; yet we look around in vain for a ventilated *public* building even, to say nothing of dwellings—where can even *one* be found? The fact is that architects have so long been persuading us that *heating* is ventilation, that they are beginning to believe it themselves! Having found it impracticable upon any principle suggested in the old and mild tempered climates, to ventilate a dwelling during a Canadian winter, they appear by common consent to have dropped the matter just where they found it without a single effort for the amelioration of our condition in this respect.*

* I must here except (amongst the Architects of Toronto, with whom I have had an opportunity of conversing) Mr. Kivas Tully, who seems fully alive to the importance of the enquiry, and very candidly admitted that Architects knew little or nothing upon the subject. This gentleman immediately recognized in my suggestions the true principle, and

If this be characterised as an utilitarian age, the style of our buildings both public and private, certainly form no part of the proof. If indeed any little improvement in this respect, has, within the last century been gaining ground, it is only where the severity of the climate has forced it upon the inhabitants. Even this innovation, slight as it is, seems to have attracted the attention of our old-fashioned gentry, especially I notice some of the clergy, in Great Britain and Ireland, and Societies have actually been formed for the purpose of checking this spirit of "innovation" as it has been termed, and forcing upon the inhabitants of this cold region of the northern parts of the American continent a style of Church and other public buildings, such as might have been fitting in England in the reign of our good Queen Elizabeth, and might have suited the climate of the southern parts of the European continent, whence it has been borrowed; but to transplant into a cold country, is about as sensible a proceeding as that would be which should direct its efforts to the introduction of breeches and stockings to the snows of Canada! Comfort, convenience and health are by such considered as secondary to what is called "good taste."

If, instead of the deeply vaulted ceiling,—thrown up to the enormous height of 40, 50, and sometimes, I believe, 60 feet,—our churches had a plane flat ceiling, not exceeding half the height, where the congregation, in winter, would be insured a comfortable degree of warmth, as well as the gratification of hearing the minister, which, of itself, is no inconsiderable advantage, the great object of their construction would be attained; and our congregations I am certain would be much increased. At present, all the old and infirm, especially if a little dull of hearing, and those of habitual delicate health—male and female—seldom think of attending service in a cold or blustering winter's day, and never at night.

being possessed of ingenuity as well as science, by force of his own judgement comprehended and almost anticipated my whole scheme.

Our churches, generally speaking, are very cold in winter, and very oppressive in summer, all for want of a convenient construction and ventilation, and are often, in my opinion, the unsuspected causes of attacks of illness in delicate persons; I can at all events speak of my own case upon this subject, feelingly. Nor can I resist, whilst upon the subject of churches, to hazard the opinion that our style of church building, is not only inconvenient for a Canadian climate, but also that it is unnecessarily expensive, and, in many places, beyond the means of the congregation to properly finish and comfortably furnish, which, instead of being the first, appears to be about the last consideration.

With respect to dwelling-houses, no part of the building should be under-ground. No cellar should ever be suffered under any *unventilated* dwelling-house at any rate. The decomposition and putrefaction, continually going on, both winter and summer, where meat, fish, butter, cheese, vegetables, and various other edibles are deposited, disseminate throughout the whole building, not only by the common staircases, but through the thousands and tens of thousands cracks, crevices, and pores of the timber, their putridity and miasma, are sufficient of themselves to breed distempers amongst the inmates, much more to aggravate the maladies to which we are ordinarily subject.

Breathing each other's breath is not the only or the greatest evil of our present unhealthy (may I say filthy) habit of living. It is the constant day and night inhaling of the miasm engendered by the saturation (encrustation I may add.) of the walls of our dwelling, our furniture, but especially our curtains and carpets, and above and beyond all our sleeping rooms and bed clothes, by the accumulations of the exhalations from the surface of the body, (no matter by what clothing surrounded, or how frequently washed,) caused by respiration, cutaneous transpiration, the products of the combustion of our lamps and candles and the effluvia from our kitchens, all of which taken to-

gether to be rendered innocuous, require the circulation of a quantity of pure air at least equal to that for the consumption of the lungs; so that 10 cubic feet per minute for each individual, is, in my opinion, rather under than over the quantity absolutely necessary to be in constant circulation through our dwellings, for the insurance of health.

And here I must again trouble you to follow me in a digression in order to prove the injurious effects produced by the miasm of a cellar, or, in fact, any other contaminated atmosphere. I quote from Professor Leibeg, who is, I believe, generally allowed to be the first chemist of the day.

Speaking of *poisons*, *contagion* and *miasm*, and their mode of action, Dr. Leibeg says: "No other component part of the organism can be compared to the blood, in respect to the feeble resistance it offers to exterior influences. The blood is not an organ which is formed, but an organ in the act of formation; indeed it is the sum of all the organs which are being formed. The chemical force and the vital principle hold each other in such perfect equilibrium, that every disturbance, however trifling, or from whatever cause it may proceed, effects a change in the blood. This liquid possesses so little of permanence that it cannot be removed from the body without immediately suffering a change, and cannot come in contact with any organ in the body, without yielding to its attraction.

"The slightest action of a chemical agent upon the blood exercises an injurious influence; even the momentary contact with the air in the lungs, although effected through the medium of cells and membranes, alters the colour and other qualities of the blood. Every chemical action propagates itself through the mass of the blood; for example, the active chemical condition of the constituents of a body undergoing decomposition, fermentation, putrefaction, or decay, disturbs the equilibrium between the chemical force and the vital principle in the circulating fluid."

Again, he says : " An animal substance in the act of decomposition, or a substance generated from the component parts of a living body by disease, communicates its own condition to all parts of the system capable of entering into the same state." And again, " The state of change or decomposition which affects one particle of blood, is imparted to a second, a third, and at last to all the particles of blood in the whole body. It is communicated, in like manner, to the blood of another individual, to that of a third person, and so on ; or, in other words, the disease is excited in them also."

Once more he says : "*Chemical actions are propagated in no organs so easily as in the lungs, and it is well known that diseases of the lungs are, above all others, frequent and dangerous.*

" If it is assumed that chemical action and the vital principle mutually balance each other in the blood, it must further be supposed that the chemical powers will have a certain degree of preponderance in the lungs, where the air and blood are in immediate contact ; for these organs are fitted by nature to favour chemical action ; they offer no resistance to the changes experienced by the venous blood.

" If the matter undergoing decomposition is a product of the decay or putrifaction of animal and vegetable substances, or causes their decomposition, it is termed miasm. Gaseous contagious matter is a miasm emitted from blood, and capable of generating itself again in blood. But miasm, properly so called, causes disease without being itself reproduced.

" Carbonic acid and sulphuretted hydrogen, which are frequently evolved from the earth in cellars, mines, wells, sewers and other places, are amongst the most pernicious miasms."

Whilst upon this subject I may as well give you Professor Leibeg's opinion upon the use of *Chlorine* as a disinfecter. I recollect that during the times of Cholera Morbus in this Province, about fifteen years ago, its use was

much resorted to, and it is, I believe, frequently used at this day about dwellings. After naming several acids which may, with advantage be evaporated in air containing gaseous contagions, he says : "Chlorine also is a substance which destroys ammonia and organic bodies with much facility, but it exerts such an injurious and prejudicial influence upon the lungs, that it may be classed amongst the most poisonous bodies known, and should never be employed in places in which men breathe."

If after these quotations, so directly in point, and taken from the writings of the ablest chemist in the world, it is still considered perfectly safe to inhabit an unventilated building erected over a cellar, or for persons of weakly constitutions to frequent an unventilated sick room, then I can only say that light and knowledge are thrown away.

We will now endeavour to make further progress in the erection of our building.

The basement story of the dwelling house being above ground, a free circulation of air should be permitted under every part, through the foundation wall. This will not only carry off all the musty vapour generated by the absorption of wet by the earth, but will also tend to preserve the timber.* After the ground floor joists are laid, the outer walls should then be built, hollow throughout. There are so many ways of building hollow walls, that I shall not attempt to describe them ; any practised mason will know what I mean, and the unpractised may easily learn. The greater the number of chimney tops (or they may now more properly be called flue tops,) the better, these hollow walls being connected with them. If hollow walls be objected to for any reason, regular flues are to be carried up from bottom to top, so that an opening made in every story of the building into one of these flues, the cold air may be thus ejected from every room in the building. These openings are made at the floor of every room, and

* The earth under the basement should be completely covered over by brick, stone, or tile, closely laid.

are to terminate in a general and lateral flue, which is made to communicate with the flue tops.

I should never build higher than eight or nine feet between joists. The lower hall should be ten or twelve feet wide. From the hall in each story there must be a complete communication by means of apertures constructed at the top of the hall and of every room, and from room to room; these may be placed either under or behind the cornices, and are to vary in size according to the number of rooms to be ventilated.*

Having now established a free communication from the *bottom* of every room, *out* of the building, and from the hall *into* the building and from room to room, it only remains to put the air in motion and then the ventilation or circulation will be complete.

It is unnecessary for the purpose of this lecture, particularly to describe the machine for warming the air for winter ventilation, nor is it necessary that I should describe the apparatus by which the pure air is brought into the building; these must form the subject of another lecture.† At present, I assume that from the machine (which if required for cooking purposes also, in winter, will be best placed in a kitchen, which I shall suppose is at the end of the hall,‡) there is ready to issue from an aperture of, say, three feet square, a quantity of air as before stated equal to 40 or 50 cubic feet per second, which would fill one room in a very few minutes, and the whole building in about half an hour.

* If there be no objection to having the doors open occasionally, these *top* apertures may be dispensed with altogether.

† It is most remarkable that the greater the quantity of air made to circulate through the building the greater will be the economy in fuel during winter! 50 cubic feet per second will supply 12 rooms with a constant circulation of 250 cubic feet each, per minute, sufficient for 25 persons; this can be effected, and at the same time keep these 12 rooms at a temperature of 70°, with much less than half the fuel which is now taken in producing the same warmth alone, without ventilation!

‡ If cooking apparatus be not required, a *ventilator* for the mere rarification of the air, set in the hall, will be as convenient and less expensive.

You will excuse me for again reminding you of the impenetrability of air ; for unless you believe, and constantly bear in mind the fact that not a single particle of air, *additional* to that already enclosed in a perfectly close room, can be brought *into* it, without allowing the same quantity and at the same instant to escape *out* of it ; and that not a single particle can escape *out* of such a room unless the same quantity be at the same instant let *into* it, all I have to say upon this part of my subject must go for nothing.

We now return to our dwelling, which we have left prepared with cold air flues in the walls, from the *floor* of each room in the building, *upward*, and connected with the chimney or flue tops ; and with the warm air apertures of corresponding size, at the *tops* of the rooms, (or the doors left open,) forming a complete communication from room to room, throughout the several stories and rooms of the building. The external air, warmed in winter, is ready to come into the hall. Now if we suppose all the *cold* air flues to be shut by means of slides, gates or fans, which are constructed for the purpose, and the house as well as every room to be perfectly close, every attempt to *force* this external air into the hall will prove abortive ; no quantity of air brought up to the aperture in the hall, plied even with a fire however intense, can force one particle into such a building. I wish you now to accompany me to any one of the rooms on the first floor, say No. 4, for example, draw the cold air slide and immediately the air rushes out in full volume of the capacity of the flue, and exactly that quantity you will find coming into the hall, *and no more*. This circulation will go on until all the cold air (if in winter) lying above the bottoms of the upper apertures be drawn *into* No. 4, and its place of course supplied with warm air, then first this room receives the warm air which will speedily fill it. The whole body of cold air lying *below* the level of the upper or warm air apertures, *in the three intervening rooms*, still lies there undisturbed, and will remain unchanged in temperature, as long

as the cold air slides at the bottom of these rooms are kept closed. In this way any or all of the apartments may be ventilated, as rapidly as the apertures will allow the cold air to escape.

To render more plain the operation of this ventilating system, suppose two rooms, the one above the other, the bottom one filled with cold water and the top one with warm, open an aperture *between* them, and no alteration in the temperature of either will take place, each will remain much the same as if no communication had been opened between them; but if we suppose a gate to be opened at the bottom of the cold room, it will then fill with the warm water as rapidly as the gate will permit the cold water to escape. It comes to this, in fact, that the ventilating a building by this process *depends upon the ejection of the cold air*; the *initiative* in the business, is indeed, *the ejection of the cold air*. In this lies the whole secret of a proper mode of ventilation.

This *ejection of the cold air*, and at the *bottom* instead of at the *top* of the rooms as we have been hitherto accustomed to, requires further elucidation, because it is at this point of the enquiry, it appears to me, where all the writers upon ventilation have departed from the right track. The original *ejection* of the air already in the room appears not to have been thought of; nor indeed under a *top* ventilation, such as would be entitled to the name of ventilation, could it be; where the temperature is required to be raised by artificial means, no quantity of fuel would be sufficient to make a house habitable. It is evident from the fact of their constantly and uniformly speaking of the "occasional opening of the doors," and the "cracks and crevices, &c.," as sufficient for ventilation, that they never contemplated anything more than a supply (of "fresh" air, as they call it,) sufficient *to sustain life*. Beyond that no effort appears to have been made by any one.

To proceed with the elucidation spoken of.—So much have we been accustomed to regard the air, when in mo-

tion, as always mounting *upward*, that it is with difficulty we shall be enabled to believe that a ventilation from or through the *bottom* can be effected at all. In pursuance of this erroneous idea that the air is always struggling to mount *upward*, it is natural for us to suppose that the pressure against the ceiling is greater than against the floor of a room, and therefore that a greater quantity of air would escape at that point. Now the very reverse of this is the fact. If "the atmosphere grows lighter as we penetrate upward," it must be heavier as we go downward, and by induction that which is enclosed must be heavier at the bottom of a room than at the top; moreover, the difference of its density alone, in a room where there is the least artificial heat, will cause a preponderance in favour of the rapidity of its egress at the bottom.

From this reasoning, then, it would appear that the generally entertained opinion that the natural motion of the air within a room is *upward*, is erroneous; and so it is. The tendency of a motion of air in its natural state is *downward* and not *upward*.

The attraction of gravitation has precisely the same effect upon air that it has upon a rock or any other substance or body. The air when rarified by heat goes *upward*, because the natural barrier, the earth, and the pressure of the cold air around it, prevents it from going *downward*; and the warm air at the *top* of a room is just as much at the *bottom* of the *external* air as if it were *without* the building, and exerts the same power of buoyancy (*downward*, as regards its *relative position in the room*, but *upward*, in fact, *as regards the external atmosphere*.) as if it were outside the building; but no one would argue from thence that because warmed air was lighter than cold air, it had *no* weight. It is only *relatively* lighter. If a body of heavy, say green oak timber, but a shade lighter than water, bulk for bulk, be placed in that element it will barely float, but place a piece of dry pine under it, and the oak will be immediately buoyed up out of the water. This is

precisely the effect which warm air introduced in a room has upon cold air; and if the sides of the room did not prevent the cold air from parting and being dispersed, it would find its way through an aperture made at the *bottom* of a room *before* the cold air! As it is, however, *all* the cold air must *first be ejected*.

It is exactly at this point, as I have before stated, that philosophers have departed from the only true principle upon which ventilation can be effectually accomplished.

It is supposed, as you have heard, that the atmosphere surrounding the earth extends upwards of forty miles. It is estimated, moreover, that "every square inch of the surface of the earth, constantly sustains a force or pressure of about 15 pounds. Thus the body of a man, the surface of which amounts to 2000 square inches, will sustain a pressure from the surrounding air to the enormous amount of 30,000 pounds." And if it were not the nature of fluids to transmit pressure equally in every direction, of course, every thing which could not sustain such a pressure would be crushed; but such being the case, and the internal parts of the bodies of animals being filled with fluids both in the liquid and gaseous states, which offer a counteracting pressure exactly equivalent to the external pressure of the air, we move about freely, without being sensible to the enormous pressure to which our bodies are subjected.

Again, with respect to the weight of the atmosphere and its pressure, in common with all fluids, being in all directions equal. It has been computed that the atmospheric pressure at the surface of the earth, will sustain a column of water 34 feet in height, that is, supposing such a column, no matter of what diameter it is, to be enclosed in a straight tube, and the pressure of the air taken from the top by an air pump or other means, it would be sustained there by the pressure upon the *lower* end surface.

Now it is to this pressure of the atmosphere we are indebted for the draught to our chimneys. Whenever heat is applied to either water, air, or any other liquid, the

immediate effect is motion, and the operation of what we term a draught, or upward motion to the air, is exactly similar to, and governed by the same laws as boiling or heated water. The heat which is applied to the bottom of the boiler warms, or in other words, rarifies that which lies next to it, and it forthwith *rises* to the top of the body; but this is caused no more by the lightening of that portion of the water, than it is to the *comparative* increase of pressure of the surrounding body of water, *downward*. Indeed these two motions, are, and must always be, simultaneous, for the obvious reason that there can be no such thing as a vacuum, nature abhors it. Precisely the same effect would follow if, instead of rendering *lighter* a portion of the water, we should *increase the weight* of that which surrounds it, namely, a motion upward. Thus, take some solid body, but a little heavier than water, bulk for bulk, this will of course sink and lie on the bottom of a vessel filled with water; now take another body heavier than water, and capable of being held in solution by it, say common salt or any other substance, when this is added, the body lying on the bottom of the vessel will rise, from the increased pressure of the surrounding body.

And this operation it is which causes a pump to work, and not, as is generally supposed, a *suction*. The drawing up of the upper valve, merely takes the weight of the atmosphere from the top surface of the water within the pump, and leaving it upon the surrounding body of water contained in the well, the water within the pump is pressed upward, in the same way as the 34 feet column of water of which I have been speaking, is sustained.

So also, precisely, is the operation of our breathing. By means of the enlargement of the cavity of the chest by an operation of the muscles, the air, by its superincumbent weight alone, is *forced* into the lungs, and this inspiration of air is not the result of any power we can exercise over it, as is generally supposed.

Now we will apply this theory to the draft required up

the flues or hollow walls from apertures at the bottom of the rooms, or which is nearly the same thing, the draught of a common chimney.

1st. The external air as well as that which is enclosed in a building is in never-ceasing motion. This is caused by heat, and in proportion as that is increased or diminished, will be its contraction or expansion. Heat will expand air from 30 to 50 per cent; and as the physical barrier of the surface of the earth or the floor of a room prevents the motion caused by its expansion from taking a *downward* direction, it *must* go *sidewise* or *upward*.

2nd. The motion of the external body of air over our chimney-tops, takes away the superincumbent weight of the atmosphere, in proportion as it increases in *lateral* weight, acting upon the draught of the chimney in much the same way as the air pump upon the top of the 34 feet column of water, and the more rapid the motion of the external air, the greater will be the vacuum created, and consequently the better the draught.

3rd. The pressure of the atmosphere is as great inside of a building as it is outside, in the same manner as the water in a vessel submerged in that element; and therefore an aperture, or thousands of "cracks or crevices" made in a room, communicating with the external atmosphere by pipes or ducts, however small, circuitous or labarinthine, or at however great a distance, will exercise the same influence upon the air enclosed in a room, as if the room were wholly uncovered. To return from this digression.—

Thus we have the building ventilated; and we will now pursue the subject, and endeavour to show in what way this ventilation is superior to the plan said to have been invented by Dr. Franklin, and so far as I know and believe, followed to this day in all parts of the world where ventilation is practised at all.

In the first place it is evident that the whole body of air in a room thus ventilated must be constantly *settling*, having a downward tendency, similar to a body of water

drawn off from the bottom of a vessel; this downward current acting directly against the rising fog of dust and putrid exhalations with which every inhabited room, but more especially a carpeted one, is always filled, keeping it near the floor, or at all events below breathing distance, and giving all the impurities, with the whole body of air, a direction toward the cold air flue, through which it finally escapes.

In the second place you secure the four-fold advantage, by this bottom ventilation, of getting rid of the coldest air in the room, instead of the warmest as in the old mode, and thus saving all the heat; of drawing the dust and miasm *downward* instead of upward, as in the old mode; of ejecting the most impure air instead of the purest, as by the old system, and of securing a less difference of temperature between the head and feet of the inmates than can possibly be effected by any other means ever attempted.

In the third place, every breath we draw is, in this *descending* body of air, *above* the preceding one, and consequently fresh and unadulterated. Moreover, the breath we *expire* is *heavier* than that which we *inspire*. "Animal respiration," says Mr. Jackson, "changes the constitution of air; oxygen is destroyed or deposited in the blood, and carbonic acid gas is given out in its stead. Thus we inhale pure air and exhale that which is foul, carbonic acid being an impure and heavy species of gas." Indeed it has never been denied, for it is undeniable that pure air in its natural state, is like water, always lighter than that which is impure, and of course will float *above*. The impure and putrid air generated in the fens, marshes and swamps, never ascends to the tops of the adjoining hills either in Europe or America. Indeed this assertion is fully borne out by the experience of others. Persons visiting caverns and even common well-diggers will attest this fact; nor could the colliers exist without numerous shafts being let down from the open air in order to discharge the foul vapour. And to these may be added the valley of death

in Java and the carbonic acid springs in Bavaria, as well as the well authenticated fact of the *Grotto del cano*, in Italy, in which a man may walk about unharmed, whilst a dog, breathing that part of the body of air lying at the bottom, immediately expires.

Further, as it affects living organism, inanimate as well as animate. It is in low and swampy grounds that the most poisonous reptiles and noxious herbs and plants are found. Few, if any, of the cereal plants which afford sustenance or nourishment to man are found to thrive in these situations. The timber growing here, although perhaps larger and coarser in texture, is nevertheless far inferior in strength and durability to that growing in airy and dry situations. Wood cut for fuel in low grounds is not worth as much as the upland timber by 20 or 30 per cent.

I need scarcely again allude to the injurious effects arising from the putrid atmosphere of our cellars, which, under the present mode of heating our dwellings is not only permitted, but actually *drawn up* into our apartments, from both cellars and cellar kitchens. This is inevitable, and it is in fact the foul vapour from them, still more contaminated by the filtering which it receives in its ascent through the cracks of the floors, pores of the timber, half an inch of dust, and the carpet itself, which constitutes the principal supply for the lungs of a family!

Before I proceed to show the chemical effects upon the lungs and generally upon health, I will remind you of the description of handicraftsmen mostly subject to this state of breathing.

Every individual human being is more or less interested, but those whose condition is necessarily most exposed to the evils of a putrid atmosphere, are all manufacturers, but especially of wool, flax and hemp, Millers, Bakers, Stone cutters, Printers, Painters, workers in cloths, metals, and paper manufacturers. I mention these out of the hosts of others, because they appear to have engaged the particular attention of medical staticians. As it respects the

workers amongst wool, flax and hemp, the amelioration of their condition by a proper system of ventilation, is too obvious to need any further remark. The dense fog of particles, visible as well as invisible to the naked eye, as well as the miasm of vegetable and animal decomposition, which fill the rooms, and of necessity are taken into the lungs, must be truly dreadful, and accounts at once for the pale haggard countenances, sickly constitutions, and number of deaths amongst the manufacturers, both in Europe and America.

There appears to be a diversity of opinion with respect to the longevity of printers. M. Chevalier, a French Professor of Medicine, denies the assertion of M. Thackrah and M. Gassicourt, that on account of the bodily infirmities and diseases with which Printers are affected, such as, of the stomach, head and eyes, and consumption, scarcely a compositor above the age of 50 years can be found; but although he makes the denial he admits his inability to prove the contrary. M. Chevalier's own view of the matter, however, induces him to recommend, amongst a great many admonitions, that printers should make use, sufficiently early, of glasses to preserve their eyes; to substitute lamps for candles; to have *the air of the offices renewed*, especially when they are being cleaned; to point out the necessity of warm clothing, and to avoid sudden transitions from heat to cold; to keep up in the printing offices an equable and medium temperature during the cold season; to choose dry and airy places for work shops, and not to dry in them the sheets wet from the press, which keep up an unwholesome air; *to renew the air of their work rooms* by opening the windows at night, and to take care during the day, and especially in the evening, that there shall be *a current of pure air from without, sufficient to make up for its vitiation and exhaustion, caused by respiration and cutaneous transpiration, and the burning of candles*; and a second time he warns them to take care not to pass from a hot room into a cold one without attention to clothing;

to be suitably clothed, and thereby preserve an equable warmth of body ; and to keep warm feet.

It is evident that whilst all these gentlemen clearly discerned the evil of an unventilated room, they knew nothing about a remedy in climates where artificial heat is required. M. Chavelier recommends, indeed, "a current of pure air from without." He does not appear to know that he is recommending an impossibility, unless the same quantity be let out the room at the same time ; and unless if that were let out at any other place than the *bottom* of the room, all the heat of the room would go with it, and not only so, but the dust and miasm would be drawn *upward*, and breathed the same as before,—something less perhaps in quantity. Now it is evident that if the fresh air be brought to a temperature ever so little *above* the air already in the room, *before* it enter, the room will begin to fill from the *top*, and if let off at the bottom will, with the constantly falling body of air, carry *downward* every particle of putridity. Thus all the evils which he has pointed out would be remedied at one single operation. The temperature of the whole establishment would be "equable." The feet would be warm, the eyes would remain uninjured, and above all,—the lungs would be preserved from dust, and the miasm exhaling from the wet paper, ink, type, as well as what is worse than all, that portion of the air which has already been in a state of combustion by the lungs, or in other words that which has already been in the lungs.

The life of a Printer is indeed a laborious one, and the least that could be expected from the owners of Printing establishments would be an ample supply of pure air, which, by preserving their health and enlivening their spirits,* would be some amelioration to the penitentiary life

* Is there a person in the world who has not experienced a pleasurable sensation upon being removed from the inside of a building to the outside, from a small, close, contaminated room to a large and airy one ; from a lower apartment to an upper one ? This sensation arises less from sight than from the effect of a purer atmosphere communicated to the blood.

to which this useful and respectable class is doomed.

Most of these remarks are equally applicable to offices, public and private, in which a number of men follow the occupation of writers, and especially to school rooms.

But it is not the French and German Professors alone who are at fault in the matter of ventilation. The English and Scotch, so far as I have had it in my power to be informed, seem equally with them at a loss. The idea of *filling* and keeping constantly supplied, an ordinary sized dwelling-house with fresh and pure air, in quantity equal to 150,000 or 200,000 cubic feet per hour, (by which not only the respiratory organs of the inmates would be supplied, but the ceiling, the walls, the curtains, the carpets, the furniture, and the floors, would be kept in a constant state of *ablution*, if I may use the term, night and day,) seems never to have been thought of, or if thought of, must be abandoned from its impracticability under the system hitherto pursued; no amount of fuel at all compatible with ordinary means being equal to the keeping up of a temperature even tolerable during a Canadian winter.

In order to form some idea of the theory of some of the scientific men of Great Britain, who have stood foremost upon this subject, I will trouble you with the substance of two or three extracts from their writings, which have very lately fallen into my hands.

Dr. Arnott says: "consumption is the disease which carries off a fifth or more of the persons born in Britain; owing in part, no doubt, to the changeableness of the climate," but he adds, "*much more to the faulty modes of warming and ventilating the houses.*"*

This gentleman finds fault with all those who had gone before him in suggestions upon the ventilation of buildings, and then himself suggests what *he* considers improvements.

* I have caused these words to be italicised, as also most of those which are so found in my quotations; I have also when it really could not be avoided, added a note of admiration.

"Whenever," he says, "a proper supply of air is admitted, an equalization of movement is essential, more particularly in crowded apartments. Nothing is easier than to remove the foul air from an apartment and introducing pure in its stead; but if not properly warmed, a most offensive and dangerous series of chilling draughts are the consequence. In rooms for invalids this subject becomes of great consequence, especially in diseases of the chest. And generally speaking, to a great number of constitutions, unequal currents are more dangerous than an oppressive atmosphere." After stating, amongst other things, "there is little or no ventilation above the level of the chimney-piece—where no other mode of ventilation is practised—and shewing that all the space above this point is and keeps filled with the stagnant products of respiration and the lamps, &c., while the fresh (?) current moves along the floor," he concludes by recommending that "hot and cold air chambers should be provided, from which a supply of cold and warm air may be obtained, and a mixing chamber for mingling the various proportions." He adds: "in ordinary apartments where nothing more can be afforded, two openings at different levels will always give much relief; the one usually admitting cold, and the other, which should be as high as possible, discharging hot and foul air."

Out of respect, and reverence indeed, to the "British Association," of which Dr. Arnott was a distinguished member, I refrain from properly characterising the inexplicable exhibition which, as a philosopher, a man accustomed to tracing effects back to their causes, he makes in the sentences which I have just quoted.

From the *Penny Cyclopædia*, published under the patronage of Lord Brougham, and a host of scientific men, I make two or three other extracts. "The supply of 4 cubic feet of air for each individual, of course involves the condition, that an equal quantity of vitiated air per minute must be allowed to escape; and the enquiry naturally follows, how does this escape take place?" After

some observations upon the weight of air. the author concludes, "From all these circumstances it is found that respired air ascends to the upper part of the room, and it follows *that the ceiling or some neighbouring part is the proper place for an outlet.*" This writer proceeds, "But it is probable that in most English rooms, provided as they are with tolerably large open fire places, and with doors which are frequently opened, the ventilation is sufficiently complete. The fresh air enters the room by the crevices around the lower part of the room, and escapes out of those at the upper part"!! Again he says, but with a little more judgement, "In crowded rooms, where the amount of vitiated breath bears a much larger ratio to the cubical contents, and where the doors are generally small compared with the height of the rooms, the impure air cannot escape by these means, and some arrangement must be made *near the ceiling for the removal of the air!* These methods are chiefly of two different kinds, the one by the use of a revolving wheel or fan, and the other by the action of a chimney or tube"!!!

Mr. *Loudon*, a great authority in architecture, I believe, after dwelling a long time upon the different modes and plans of his predecessors and contemporaries, comes to the sage conclusion that as "hot air will ascend and cold air descend, the hot must be admitted at the *bottom* of the room and the cold at the *top*; and then," he says, "they *must* mix!" These theories would work well enough if the gentlemen whom I have above named could find a room *without any air in it already!* otherwise how can they "mix" and "mingle?" And if they allow any part of that which is already in the room to escape at the "*top*" all the *heat* of the room would there escape with it, and what is of infinitely more consequence, the dust of the room and miasm of the cellars, &c., must be constantly taken into the lungs of the inmates.

But it is needless, indeed I did not intend to *argue* the point, I merely quoted a few passages, more for the pur-

pose of corroborating what I have stated in regard to the fact that great and small, learned and unlearned, are equally at fault upon the *philosophy* of the subject. All these gentlemen, Sir John Sinclair, Reid, Loudon, Professor Napier, with some others of less note, differ somewhat in the *detail*, but their *principle*, if any there be in it, is precisely the same. They talk of "cracks," "crevices," "apertures," and "doors," they "diffuse," "mix" and "mingle," and make a very confused, intricate, and great matter of one of the most beautiful and simple operations of Nature.

What says Professor *Leibeg*, further upon this subject of miasm. "The contact of air with venous blood is limited to a very short period of time by the motion of the heart, and any change beyond a determinate point is, in a certain degree, prevented by the rapid removal of the blood which has become arterialised. Solid substances, such as dust from vegetable, meal, animal, wool and inorganic bodies, act in the same way as they do in a saturated solution of salt in the act of crystallisation, that is, they occasion a deposition of solid matters from the blood, by which the action of the air upon the latter is altered or prevented. The chemical process of slow combustion in the lungs is accelerated by all substances in a state of decay or putrefaction." Again, "When the process of respiration is modified by contact with matter in the progress of decay, when this matter communicates the state of decomposition, of which it is the subject to the blood, disease is produced." Again, "If the matter undergoing decomposition is the product of disease, it is called contagion; but if it is the product of the decay or putrefaction of animal or vegetable substances, it is termed *miasm*. Miasm properly so called causes disease, without being itself reproduced." Once more, "Every chemical action propagates itself through the mass of the blood; for example, the active chemical condition of the constituents of a body undergoing decomposition, fermentation, putrefaction, or decay, disturbs the

equilibrium between the chemical force and the vital principle of the circulating fluid."

If I am rightly informed the House of Commons is heated from the floor and side walls, both of which are perforated sufficiently to admit the hot air from their cavities. The members are thus baked, literally kiln-dried. The ventilation takes place, of course out of the *top* of the room. This subjects "the collective wisdom" of the nation to all the evils which I have described as incident to such a system. I admit that the feet should, as far as possible, be kept warm and dry, both indoors and out of doors; but that it can be healthy and proper for a person to live in a situation, where a constant and active heat is applied to the soles of his feet, I leave to the "Faculty" to determine.

My authority for the statement of the manner in which the House of Commons is ventilated, and that a Mr. Perkins is the operator, is mere hear-say, I have, however, the authority of the proceedings of the British Association for the advancement of Science, for the following statement of Dr. Reid, who ventilated the old House of Commons. "Dr. Reid explained the mode he had adopted to ventilate the House of Commons, which he illustrated by diagrams and demonstrated by the exhibition of a glazed model of the House. The current of fresh air could be introduced either from below or from above, diffused uniformly and not by violent draughts, but, as it were, insensibly, and was under the most exact controul as to quantity. The air when used for respiration or combustion was conveyed away in an opposite direction to that in which it had been introduced. The products of combustion should, if possible, be carried off so as not to interfere with the immediate supply to each individual. For the purpose of raising the temperature, hot water was used in iron tubes, not raised above 150°."

"If possible," says Dr. Reid, "the products of combustion should be carried off, &c." I agree with him; but

according to his plan of admitting the air into the room, and carrying it out in "an opposite direction," it is *not* possible; and he sees it to admit this. It is evident that in any such lateral current through a room filled with people, those at the *leeward* side must inhale those "products of combustion" thrown off the lungs of those on the *windward* side. He does not appear to have had the least idea of giving these "products of combustion" a *downward* direction, by which every individual in the room, be they many or few, inhales at every succeeding breath, the fresh air. He is right in stating that the air in a room should not be brought up to more than 150°. My opinion is that that is considerably too high.

In a climate like that of England, for the greater part of the year I do not deny that a large quantity of outside air might be carried through a building or room of the size of the House of Commons without any very great danger to the health of the members, who, I believe, generally wear their hats there; but let us take a case of every day's and night's occurrence, when the thermometer stands at or below zero in Canada.

Suppose a Court room, Meeting house, or Lecture room, 50 feet square and 20 feet high. This building contains 50,000 cubic feet. Now let in an audience of 200 people, each one of these destroying by combustion of the lungs and cutaneous transpiration (to say nothing about the stoves or lamps, or candles, if in the evening,) 10 cubic feet of air per minute, in 25 minutes every particle of this air will have been breathed. What next? The idea is too revolting for description. How, I ask, will the supply of "fresh air" through "the doors," "windows," and "cracks and crevices," mentioned by these philosophers, square with our ideas of the necessity of the case? It is well that the Judges and Lecturers are generally placed near the walls and windows whence they get the first chance at the air from the "cracks" and "crevices," or they would soon be utterly incapacitated to fulfil their duties.

Yet because we cannot *see* the pollution by which we are surrounded, under such circumstances, we are content with, because unconscious of, our situation. Because we cannot *feel* the difference between this and a pure atmosphere of the same temperature, we do not suspect its impurity. *Smell* it we can and do, but having been born to such a state of things and knowing our helplessness we submit to our fate with a feeling similar to that by which the Western Africans are actuated when the headsman appears with his scimiter to take off their heads for sacrifice ; we are incapable, because we do not understand how, to make a single effort in order to escape !

Perforated floors for churches and other public buildings, not covered with carpets, I should certainly recommend ; but for exactly a contrary purpose than that in the House of Commons. I should *there* let the cold air *escape*, and if these perforations were made in blocks, they might be conveniently opened and shut by false sliding floors underneath. It is useless here to speculate upon the many ways in which these apertures of which I have been speaking, may be constructed (behind the skirting and cornices, and many other ways,) so as to prevent a disfiguration of the rooms.

Wooden buildings may be ventilated with equal if not greater facility than those built of stone or brick.

If objection be made to the apertures in the tops of the walls, the doors, if left open will answer the purpose as has been already stated.

I have hitherto been mostly considering a winter ventilation. If I have succeeded in impressing you with the belief that a purification of our dwellings is necessary during the cold season of the year, I cannot doubt but you will agree with me in estimating it at its proper value, during our hot summers.

It is true that in the very warmest weather, we frequently open our doors and windows, in those apartments most commonly used, in order to gratify our sense of *feeling*,

and by this means a partial ventilation is obtained ; but our cellars, attics, and sleeping rooms, are generally left to chance and careless servants ; and at all events no pains are taken to open a draught *through* the house. The lower part of a single window in a bed-room may perhaps be pushed up for half an hour, so that it is easy to perceive that the greatest body of stagnant air lying as it does above the aperture caused by opening the window, may remain there for weeks—perhaps months ; if the *door* of the room be not also opened this must be the case ; and yet this apartment may be occupied as a sleeping chamber in an atmosphere up to 80 or 90 degrees !

It is during the hours of sleep, when the blood resumes its natural circulation, undisturbed by the excitement of the business of the day, that it is least capable of resistance to the influences exerted by contact with the impurities of the atmosphere, and it is to a proper ventilation therefore of our sleeping apartments that our most anxious thoughts should be directed. In our hitherto unventilated houses, instead of selecting the largest, highest, and most airy rooms for sleeping chambers, we are in the habit of sacrificing our health to a name for a magnificent suit of dining rooms, drawing rooms, parlours, libraries, &c., heedless—unconscious it may be—of the foundation laid, by our vanity perhaps, for the propagation and perpetuation of (I wish I could say) a *long* line of diseased offspring. In an unventilated dwelling, the sleeping chambers should be the largest rooms, all the inner doors of every room should, upon the inmates retiring to bed, be thrown open ; every article of bed clothing should every morning be exposed, *separately*, to the pure air, upon an airing gallery, which should form an indispensable appurtenance to every dwelling. No one should sleep in a single article of clothing which had been worn during the day. No person who has not made experiments upon the subject can estimate the amount of putridity absorbed by bed clothes and wearing apparel, especially if they are made of wool. It is indeed

for this very reason, its power of absorption of the cutaneous transpiration, that woollen fabrics are considered the most healthy for clothing. Woollen clothes should never be kept in drawers, they should hang singly in a wardrobe, drenched, if I may use the term, with a circulation of pure air. Air enclosed in a tight room, closet, or drawer, stagnates and putrifies the same as water when confined, and this should on no account be suffered. If we wish to be convinced of this we have only to walk into such a room or open such a drawer.

Another practice to which I decidedly object is very common,—the use of an ordinarily occupied bed-room for a *sick* room. This should not be. I am aware that every house-keeper cannot afford to appropriate a room for the sick only, but to those who can afford (and they are generally those who most frequently require) it, I strongly recommend the especial appropriation of one of the largest upper rooms to this object. This place should be kept without carpet, curtains, or furniture made of any cloth fabric whatever, except the bed linen. The bare boards or an oil cloth to walk upon and no curtains, nor woollen bed clothes, unless these latter are very frequently aired and changed. This room, moreover, should be well *lighted*. Light has the same effect upon the human that it has upon the vegetable organism. A plant will grow in a dark cellar, but it will always be pale and sickly, nor will it ever bear perfect fruit or indeed come to maturity. The practice of *darkening* a room in which the invalid or sick person is confined, is, in my opinion, pernicious. To avoid the glare of the sun an eastern or northern aspect in the building, in this latitude, should be chosen. I have somewhere read ~~an~~ an official report made of the number of deaths for a series of years, in an hospital in Edinburgh, in which it appears that the mortality in the front wards was less by 30 per cent. than in the back wards of the building, which were dark, being hemmed in by the high walls of adjoining erections.

In a properly ventilated building, the necessity of most of these precautions would be obviated.

In the best kept dwelling close up any one room for one day and night only, during the hot weather, and no one can fail to be convinced of the importance of *keeping up* an incessant circulation of fresh air, throughout our houses. In buildings which happen to be left tenantless, and more especially in our churches and other public buildings, the advantages resulting will be very considerable. No one can have failed to notice a marked difference in the sensation experienced upon entering a church or other public building, and that perceived in a dwelling house; nay there are no two dwellings even alike in this respect; and however pure or impure they will be disagreeable or agreeable exactly in proportion as they may happen to differ from that to which we have been accustomed, and, not as we would naturally suppose, in proportion to their purity or impurity. The sense of smelling is, perhaps, of all the other senses, the most fallible guide for us to appeal to in cases where the purity of the atmosphere is to be judged of.

I have already shewn how fallacious are the senses of feeling and seeing, and I must now endeavour to impress upon you the necessity of placing no dependence whatever, in the management of our dwellings upon the sense of smelling.

"Of all the organs of sense," says Dr. Lardner, "that whose nervous mechanism appears to be most easily deadened by excessive action, is that of smelling. The most delightful odours can only be enjoyed occasionally, and for short intervals. The scent of the rose, or the still more delicate odour of the magnolia, can be but fleeting pleasures, and are destined only for occasional enjoyment. He who lives in a garden cannot smell the rose, and the wood cutter in the southern forests is insensible to the odour of the magnolia.

"Persons who indulge in the use of artificial scents soon cease to be conscious of their presence, and can only sti-



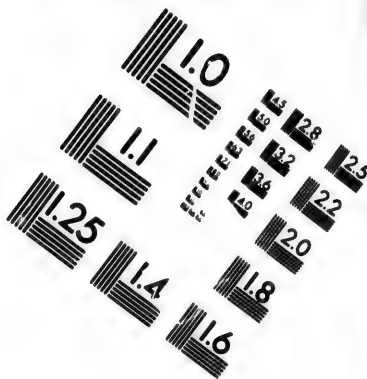
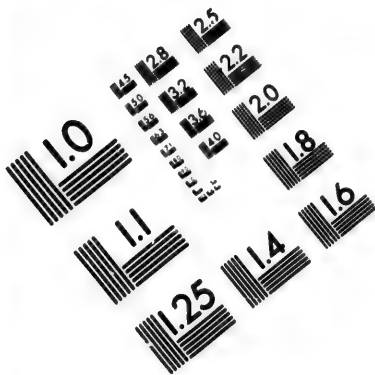
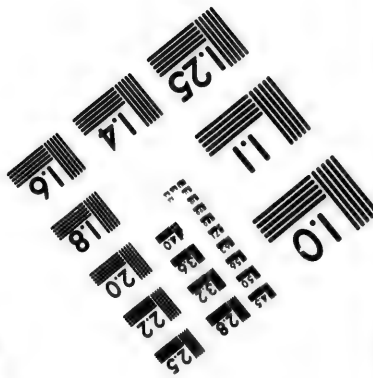
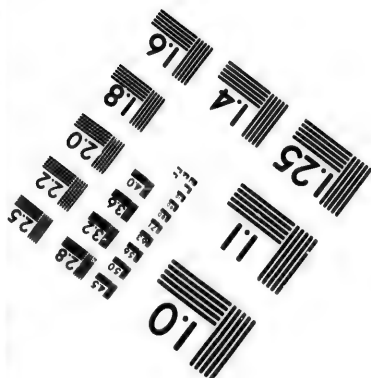
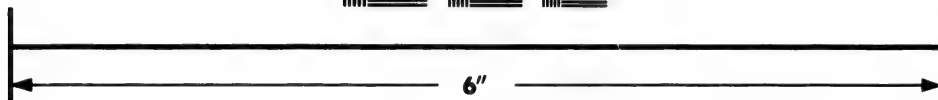
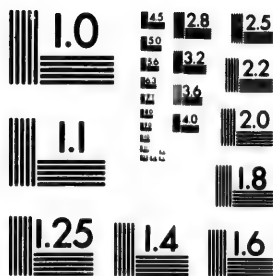


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multate their jaded organs by continually changing the objects of their enjoyment."

But every day's experience must convince the most careless observer of how little dependence can be placed upon the sense of smelling. We move into a new tenement, we are at once sensible of a difference of smell, in a very few days we become insensible to it. We walk into a different apartment of the same building even—perhaps our own—we notice a peculiarity. We notice the loathing with which a person comes into one of our prisons, in a few days he ceases to complain. In short such is the uncertainty of our organs, that, delicate and refined as they are, if our health depended solely upon their indication, they would be worse than useless to the human family; certainly we cannot take them as a criterion by which to judge of the purity of the air we breathe.

Under these circumstances, our only resource evidently, is to apply to Nature. She is always, I repeat, the safest guide in anything which regards our physical wants. She has provided, and provided abundantly, a standard for us to go to—that universal purifier, the common atmosphere, which, notwithstanding all the labour which it has had to perform for thousands of years, is yet just as pure as at the beginning, and just as willing to perform its part as it ever was. We, however will not allow Nature to do her office; we studiously shut her out of our dwellings—our dwellings, I say, for it is there, if any where, where her powers of purification are needed, it is there where she can be of most use to us, and it is there therefore, blow high or blow low, sunshine or rain, be the weather warm or cold, where she ought freely and constantly to have undisputed sway. Without pure air, no part of mankind, those who "live in ceiled houses" especially, can ever be a healthy race of people; and *more* especially will it be so with those who inhabit a cold climate.

Sir John Sinclair, in remarking upon the beneficial effects of country air to the inhabitants of towns, extracted

from Wilson's travels, says "the above remarks on air, are equally lively and just. Indeed when the imperious necessity for constantly repeated inspiration and expiration is considered, and the very short time that any of the more complicated animals can exist, if deprived of air, it would appear that a constant supply of that fluid, in as great purity as possible, is more immediately requisite for the support of life, (and health) *than any other external circumstance whatever*. The very spirit of vitality seems, through the medium of the lungs, to be derived from the atmosphere."

In considering the evils attendant upon a want of a system of ventilation within our dwellings, I have hitherto made no distinction in the diseases which may be engendered or aggravated in consequence; because in most of these, the medical profession, by a long course of collation of facts, and the application of scientific enquiry has been enabled to grapple with and master them, but there is one disease which has baffled their utmost skill. It is the most terrific of all, and from its unconquerable nature drives us to the only alternative—its *prevention*. It is in this view of the subject that I originally instituted my experiments, and have ventured to approach and publicly discuss the system of ventilation before you, believing as I do, that if followed up, it will not only prove to be a preventive, but will, with the blessing of God, immediately check its awfully rapid progress. To this end chiefly will the remainder of this paper be directed to a notice of what I consider the most fruitful source of this disease.

Upon *mothers*, in my humble opinion, rests the greatest responsibility as it respects the communication of any acquired or hereditary taint in the blood. In outward form and developement of all the *physical powers*, children more frequently resemble the father, whilst in nine cases out of ten the *mind* will receive its impress from the mother. We seldom see a clever family of children who have not had a mother of strong intellectual powers, and vice versa. And

so it is with respect to the transmission of any disease developed by means of an affection of the blood. It is to mothers therefore, and indeed all females, that, before closing my remarks, I would address a few hints which, however they may come from an unprofessional man, are, nevertheless the result of long experience and a close attention to the subject.

In most families there are persons, and especially among the females, more or less delicate in constitution, and frequently, invalids. How much it behooves all such to be ever on the watch for the preservation of that portion of health and strength which the Almighty has vouchsafed them, I leave to the physician to determine; but there is one practice common amongst *ladies*, which is so palpably mischievous that I cannot avoid specially referring to it.

When about going out in winter they are in general commendably careful in securing themselves against the cold; but they, without any hesitation, and at all times, visit rooms, up stairs and down stairs, in their half warmed dwellings, whose temperature is as low as it is outside the building, without any additional clothing. Not only so, but they without scruple sleep in an atmosphere down to zero, after having spent 15 hours out of the 24 in one up to 70 or 80! How health can be maintained, even by an ordinarily healthy person, under such circumstances, it is difficult to imagine.

Under a proper system of ventilation, these sudden transitions from heat to cold within our dwellings would be effectually avoided, the same temperature would be found in every room by night and by day.

M. Foissac, speaking of the peculiar effects occasioned by hot and cold climates upon the constitution, says that "the cutaneous transpiration, undergoes, from the effect of temperature, more considerable variation than the pulmonary transpiration, it being even probable that the one is destined to replace the other. This close correspondence will account for the frequency of pulmonary diseases occa-

sioned by the impression of cold made on the surface of the skin."

The same author, quoted by the *Edinburgh Medical and Surgical Journal*, says again, speaking of consumption of the throat and the liability of females to its contraction, "that some of the causes are great extremes and sudden transitions in the atmospherical air. Of the former, dry heat and great cold, and of the latter, transition from a hot to a cold air, and inversely. Hoarseness," he says, "will be brought on in a person predisposed to the disease, if he be exposed to a temperature which differs much from that in which he habitually lives. It is a fact also, worthy of commemoration, that the hoarseness is greater when the patient passes from a cold to a hot air, than it is when the transition is from a medium to a cold temperature."

Professor E. H. Barton, M. D., New Orleans, on a comparison of deaths by pulmonary consumption in warm and cold climates, states that whilst the deaths in the northern cities of the United States from this disease amount to 1 in 4, those in New Orleans amount to 1 in 30. Thus making the difference against the northern cities more than 7 to 1.

The cause assigned by Dr. Barton is this;—"In the north the most active apparatus of the system is the respiratory, on account of the great demand for caloric to enable the inhabitants to withstand the influence of cold on their systems; and hence the predominance of their pulmonary diseases over others. But on coming to the south where this increased temperature is no longer required to preserve the integrity of his organisation, this active demand on the respiratory system is diminished, and transferred to other systems, &c.

This gentleman has here stated and proved by, no doubt, accurate statistics—a fact, that no one has ever denied or can deny—that deaths from consumption, in cold climates greatly preponderate over those in warm regions; but the reason which he gives, viz. the greater activity of the respiratory apparatus required in a cold climate in order to

supply the additional quantity of caloric required in a low temperature—is falacious.

It has already been stated, on the authority of Mr. Jackson, of Edinburgh, that the atmosphere, weight for weight, contains the same constituents all over the Globe—in the torrid as in the frigid zone—but bulk for bulk there is nearly double the quantity in the coldest than there is in the hottest climate. If then, as Dr. Thompson has it, a man in ordinary health and in a temperate climate, say 70° , inspires 40 cubic inches of atmospheric air, containing one-fifth, that is, 8 inches of oxygen, it follows that the respiration necessary in a temperature of 100° , in order to supply the lungs with the same quantity of oxygen, must be of nearly double the rapidity of action which would be required in a temperature down to zero; and that, therefore, so far from the “respiratory apparatus” being more active in a cold climate than in a warm one, the very reverse is the case.

Dr. Foissac, however, whom I have before quoted, settles the matter when he says, “In cold countries, and during winter, the respiration, instead of being accelerated, as some authors have stated, is perceptibly retarded; but a greater quantity of oxygen is absorbed; a more electrical and less rarified air enters the lungs. The result of this is, a more considerable disengagement of caloric. Nor is Dr. Barton more fortunate in his statement that less caloric is required in warm than in cold climates. Titsing, quoted by Dr. Foissac, says that the animal heat is less in the people within the tropics, than in those beyond them. Ross and Parry advanced as far as 74° north latitude, there the alcohol thermometer marked 60° below zero, without this extreme cold producing any material diminution in the temperature of the body. Neither does external heat, says Dr. Foissac, appear to have a more marked effect than cold on the phenomenon of animal heat. The Russians, Poles, and Swedes, can endure the air of stoves heated to 167° without inconvenience.

But it is needless to multiply quotations in order to prove that Dr. Barton has not satisfactorily accounted for the different effects of climate upon this disease ; we know from every day's experience that whilst in a very cold day we are obliged to make an effort to prevent too much air from entering into the lungs, in a hot day we are panting after more.

When a great and an alarming fact, such as has been stated by Dr. Barton, and which cannot be controverted, that mortality from affections of the lungs is so much greater in cold than in warm climates, is laid before us, certainly it is not unnatural that we should look for a reason—a cause not confined to a locality or an isolated case, but one consistent with the whole range of philosophical enquiry.

I will not take upon myself to deny that there may be instances of accidentally caused affection of the lungs, but this I do say, that within the whole range of my experience, and it has been an extensive one, I can call to mind but one single instance of death by this disease, which was not clearly traceable to *contagion*, either mediate or immediate.

My belief is that a very large majority of the people comprised in the classes which I have designated as the sedentary population of all countries, by being necessarily shut up within the contaminated atmosphere of artificially heated dwellings for the greater part of their lives, have contracted a predisposition to this disease, which has descended, and which will continue to descend to their children from generation to generation, and that—so long as we continue to live without properly ventilated dwellings—unless we are ever on the watch, and successfully ward off through care and attention all those excesses, especially those sudden transitions of temperature, which are becoming every year more fruitful in awakening this insidious predisposition, we may expect this disease to continue its onward course in frequency as well as virulency, in proportion as it becomes, through the lapse of time, inherent

in the population, and instead of the deaths being 7 to 1, it will become one universal epidemic.

To conclude.

If in my anxiety to make myself understood, I have been too diffuse and particular in my manner of treating the whole matter ; if I have manifested an earnestness beyond what you may consider it merits, or if I have attached too much importance to the subject, the excuse I have to offer is, that it has for the last few years been, from circumstances, so forced upon my attention that I could not avoid giving this public expression to my opinion, that the cause of this disease must be sought for in the contamination of the blood alone, and that nothing short of a remedy co-existent with such contamination, can ever have the slightest effect in withstanding or checking its ravages ; and although this be a tedious and circuitous route, yet I am firmly persuaded that it is the shortest as it is the *only* road to its ultimate extermination.

If, then, we are convinced that in our present unventilated and unpurified dwellings we breathe an atmosphere, the life-giving principle of which is destroyed by heat and saturated with impurities, shall we persist in it because we cannot *see* it ? If we are satisfied that we are subject to a temperature which is unhealthy, shall we continue to remain so because we cannot *feel* it ? If we are by night and by day surrounded by a body of air in every way contaminated by putridity, shall we take no means for its expulsion because we cannot *perceive* it ? In short, if we are convinced that our external senses are not to be trusted as regards our general health, shall we wilfully neglect those precautions, which we are so willing to adopt when some *immediate* instead of remote calamity awaits us !

If this dreadful malady which carries sorrow and desolation into thousands of families, be not contagious and spring not from contamination of the blood, either remotely or directly, why has it, for so many hundreds of years defied the skill of the whole medical world ? If it do spring

from that cause let us make an effort at least to rescue our children from its awful ravages. The disease, once developed, we know is incurable, our only hope, therefore, as I have before stated, lies in PREVENTION. To this end, then, let us turn our most serious attention and earnest endeavours—exertions which we owe alike to ourselves, our country, and our children—by adopting such means as will be most likely to strike at the root of the evil, and lay a foundation by which, ultimately, under the blessing of the Almighty, we may expect to effectually extirpate this predisposition to a disease the most awfully appalling to which the human family is subject; a disease which (in the words of an eloquent writer) so prepares its victims, as it were, for death; which so refines it of its grosser aspect, and throws around familiar looks unearthly indications of the coming change—a dread disease in which the struggle between the soul and body is so gradual, quiet and solemn, and the result so sure, that day by day, and grain by grain, the mortal part wastes and withers away, so that the spirit grows light and sanguine with its lingering load, and feeling the immortality at hand, deems it but a new term of mortal life—a disease in which life and death are so strangely blended, that death takes the glow and hue of life, and life the gaunt and grisly form of death—a disease that medicine never cured, wealth warded off, or poverty could boast exemption from—which sometimes moves in giant strides, and sometimes at a tardy, sluggish pace, but slow or quick is ever sure and certain.